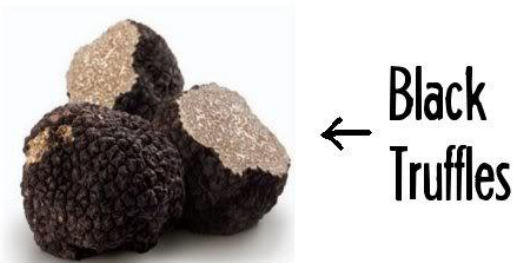
Lesson no 36 Truffle & Mushroom.

Encyclopedia of Truffles & mushrooms: -



Kamaat (الكمأة) mentioned in Hadees, according to many scholars is Truffles. But many scholars believe that Kamaat (الكمأة) is Mushroom. Both come under the topic of Kamaat (الكمأة). Truffles seem to be more proper as Kamaat mentioned in Hadees. There are many types of Mushrooms & truffles. Both are products of fungus. It is said in Hadees that they are among MANN means a blessing, may be because it grows by itself & do not needs human efforts.

Mann is mentioned in Quran & Mann is a blessing thing that grows or develops by itself (naturally by Allah's Will) means we do not need to plough or cultivate it; in Hadith it is mentioned by the name of Kamaat & also mentioned that it is among Mann; in Hadith it is mentioned that water of Kamaat is cure for eye diseases. For detail Islamic study on it please read my English book Tibb e Nabawi part 2, lesson 68, page 239 onward or visit my website www.tib-e-nabi-for-you.com or direct link to lesson Mushroom & truffles http://www.tib-e-nabi-for-you.com/kamaat.html

It is mentioned in following books of Hadith (names of book of Hadith & reference are also given): -

Bukhari : 4478; Tirmizi : 2211; Ibn Majah : 3579, 3581, 3582; Abu Nuaim : 258 etc.

- **NAMES OF TRUFFLES: -**

1. In Hadees it is called as Kamaat (الكماة)
2. In Hindi it is called as Kukuramutta. (Means can be eaten)
3. In English it is called as Earthnut & Truffles.
4. In Urdu it is called as Khambi.
5. Its family is Tuberaceae.

- **NAMES OF MUSHROOM: -**

1. In Arabic it is called as Fatar (فطر)
2. In Urdu it is called as Khambi, Kullah bazan, Saap ki Chhatri, Futr.
3. In English it is called as Mushroom.

- ***Truffles: -***

Truffles are subterranean edible fruiting body underground fungus that grows underground near the root of trees. Truffles are ectomycorrhizal filamentous fungi belonging to genus *Tuber,* naturally found across a range of climates in the Northern Hemisphere.

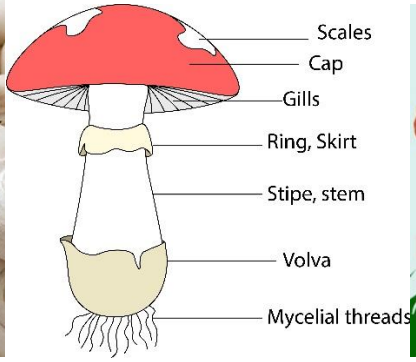
Truffles only grow in the wild and are found by gatherers with the use of dogs and pigs, who are the only trainable animals with keen enough noses to sniff out the black treasure. Pigs are able to find truffles better, but dogs are often the animal of choice because they are much less likely to consume the truffle when found. Its spores are dispersed by fungivores (animals that eat fungi). Almost all truffles are found in close association with trees. It is used as a food additive in cooking. The truffles improve the flavour & have many health benefits. According to modern science truffles are good sources of protein & have all types of amino acids in it; it contains carbohydrates, glycogen, and fungus cellulose. It has no cholesterol; & is very helpful in Trachoma (a deadly eye disease which causes blindness). Tuber truffles fruit throughout the year, depending on the species, and can be found buried between the leaf litter and the soil. The majority of fungal biomass is found in the humus and litter layers of soil.

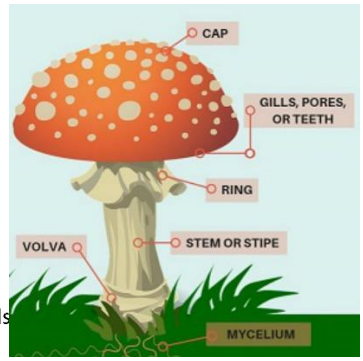
- **Mushrooms: -**

Mushrooms are fleshy, spore-bearing fruiting body of a fungus, typically produced above ground on soil or on its food source. The term "mushroom" also is used to designate the entire fungus with a fruiting body. The term mushroom is broadly use.

The term mushroom is also associated with fungi that have a stem (stipe or stalk), a cap (pileus), and gills (lamella, the papery ribs under the cap of a mushroom), the term can also refer to a wide variety of gilled fungi with or without stems and more generally any fruiting body.

Also the standard name "mushroom" is also used for the cultivated edible white button mushroom, Agaricus bisporus, they have a stem (stipe), a cap (pileus), and gills (lamellae, sing. lamella) or pores on the underside of the cap. These pores or gills produce microscopic spores that help the fungus spread across the ground or its occupant surface. Most mushrooms that are sold in supermarkets have been commercially grown on mushroom farms. The most popular of these, *Agaricus bisporus*, is safe for people to eat because it is grown in controlled, sterilized environments.





"Mushroom" describes a variety of gilled fungi, with or without stems, and the term is used even more generally, to describe both the fleshy fruiting bodies of some Ascomycota and the woody or leathery fruiting bodies of some Basidiomycota, depending upon the context of the word. Forms deviating from the standard morphology usually have more specific names, such as "puffball", "stinkhorn", and "morel", and gilled.

- ***Where to find truffles: -***

Look for the truffle under the trees where specific insect, the suillia fly. This fly lays eggs where truffles grow, above ground near the bottom of the tree, the insect flies close to the ground where the truffles grow. Truffles are ectomycorrhizal fungi, so are usually found in close association with tree roots. Many truffles will develop distinctive odours as they mature, those that are considered false truffles may have a disagreeable odour rather than a rich mushroomy odour. True truffles usually have channelled, marbled or hollow interiors and do not have an internal column. White truffles and black truffles both grow in similar circumstances (underground, around tree roots, in neutral or alkaline soil), but they are each different from one another. The truffle is a seasonal fungus with varying growth patterns depending on the variety of truffle and its native country; they cannot be seen on the surface of the soil with the naked eye. A trained animal is required to find truffles. Traditionally, for centuries, this animal was a pig; today, it is often a dogs, as pigs have a bad habit of eating the truffles they find until the animal's handler can stop it.

- ***Where to find mushrooms: -***

Mushrooms are most commonly found in dung deposits, grasslands, woodlands, gardens, and disturbed areas. P. cubensis and Panaeolus cyanescens are well known dung loving species. Mushrooms are found almost everywhere, but not all mushrooms are found in all kinds of habitat. Where they grow, such as coniferous forest, oak forest, etc., is the mushrooms' habitat. Some mushrooms develop in only one kind of habitat, such as a bog, a forest, or an open lawn or meadow. And normally a good season to get mushroom is when there's been plenty of rain.

- ***Characteristic of truffles: -***

Truffles are strong-smelling underground fungus (*Tuber* and other genera, family Tuberaceae) that resembles an irregular, rough-skinned potato, growing chiefly in broad-leaved woodland on calcareous soils; typically, 3 to 12 inches in length and are rather unattractive, resembling dung more than an edible substance. The skin is wrinkled and can range from off-white to a solid black in color. Their flavor is piquant and aromatic, and they have been esteemed as a delicacy from ancient times.

Aroma of it can range from mild to intense & vary from garlicky, pungent & dusty like; its aroma can be due to these compounds 2-methylbutanal, 3-methylbutanal, dimethyl-disulfide (DMDS); dimethyl-sulfide (DMS); 2,4-dithiapentane, tuberoside & many phytosterols.

- ***Characteristic of mushrooms: -***

Mushrooms are unique because they differ from bacteria, which do not have a cell nucleus; they are not plant because mushrooms do not make their own food through photosynthesis; and they differ

from animals because they are not mobile and do not absorb nutrition externally. Mushrooms are, however, related to other fungi organisms such as, yeasts, molds, and mildews.

All mushrooms are fungi, but not all fungi are mushrooms. For those fungi that produce them, the mushroom plays a similar role to a flower or a fruit in plants. Some part of each mature mushroom produces microscopic spores that are similar to pollen or seeds, sometimes numbering in the trillions. Most mushroom-producing fungi are members of the phylums Basidiomycota or Ascomycota. The technical difference between these groups has to do with how the spores develop, which can be detected only by using a microscope. However, the "ascos" (ascospores) are less frequently noticed and are often shaped like small cups. Probably the best-known ascos are the highly prized morels (genus Morchella), which typically fruit in the spring.

Mushrooms have many fascinating properties; some mushrooms are edible & some are extreme toxic. Some types of mushrooms grow extremely rapidly & masses of mushrooms can seemingly appear overnight, under suitable environmental conditions, and usually following a heavy rainfall. Mushrooms may also have unusual shapes and growth patterns, for example, the concentric circles or "fairy rings" that some species develop in open places, such as fields and meadows. As a result, mushrooms have acquired a supernatural reputation in some cultures, and are commonly associated with cold, dank, dangerous, or evil contexts. Many cultures have similarly regarded a few other creatures, such as snakes, bats, and spiders. Today, however, these various cultural prejudices are much less prevalent, because we have a greater scientific understanding of the biology and ecology of mushrooms and other unusual organisms.

- ***Classification of truffles: -***

Over 100 different types of truffles grow all over the world, but only 10 kinds are edible; & the most common edible truffles are white truffles and black truffles.

- ***Classification of mushrooms: -***

Edible mushrooms: -

- Coprinus comatus is an edible basidiomycete with a growth habit similar to agarics. It is commonly found in temperate climates in the northern hemisphere and prefers to grow on rich decomposed substrates. Fruit bodies tend to appear in clusters. It is commercially cultivated in China and by amateurs all over the world. Following mushrooms are also edible 1. Agaricus Family Field Mushroom (Agaricus Campestris) 2. Armillaria Family Honey Fungus (Armillaria Mellea) 3. Auricularia Family Jew's Ear (Auricularia Judae) 4. Boletus Family Bay Bolete (Boletus Badius) 5. Cantharellus Family Chanterelle etc.

Medicinal mushrooms: -

Some species of mushrooms have been used as medicine for thousands of years, particularly in China and Japan, some of the immune- enhancing and anti-cancer effects of traditional species such as Ganoderma lucidum and Trametes versicolor have been demonstrated scientifically regular consumption of oyster mushrooms has been shown to reduce cholesterol. Researchers from Johns Hopkins University have recommended that psilocybin, the active compound in hallucinogenic mushrooms, be reclassified for medical use, potentially paving the way for the psychedelic drug to one-day treat depression and anxiety and help people stop smoking. Hallucinogenic mushrooms are also called as magic mushrooms are wild or cultivated mushrooms that contain psilocybin, a naturally-occurring psychoactive and hallucinogenic compound. Psilocybin is considered one of the most well-known psychedelics, according to the Substance Abuse and Mental Health Services Administrations.

Poisonous mushrooms: -

The common death cap (Amanita phalloides) or its relatives can be fatal if eaten. There are several other species that can be deadly if eaten, but all known species can be handled safely. However, relatively few mushroom species are dangerously poisonous. Many more species, including the commonly illustrated Amanita muscaria, can cause stomach pains, vomiting, or diarrhea. Even the popular morel is toxic if eaten raw.

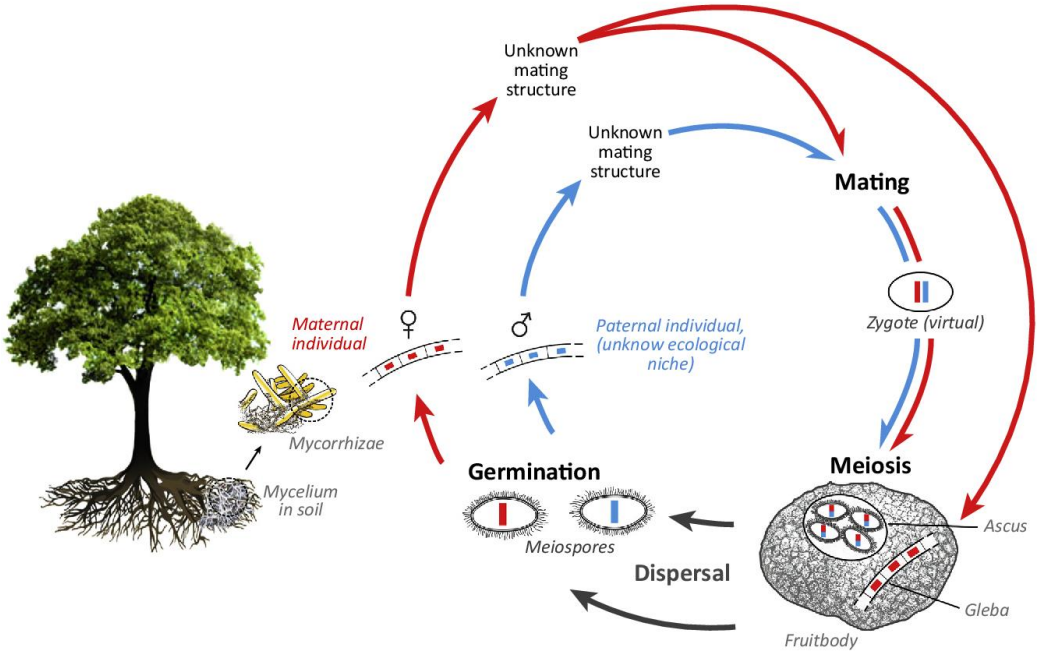
- ***Species of truffles: -***

There are hundreds of species of truffles & all are mycorrhizae; the best-known truffles are the black, or Périgord *Tuber melanosporum,* and the white, *T. magnatum,* both found chiefly in W Europe.

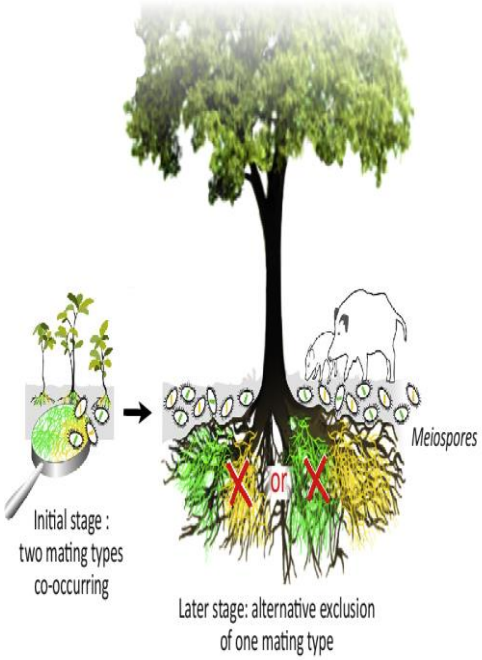
- ***Species of edible mushrooms: -***

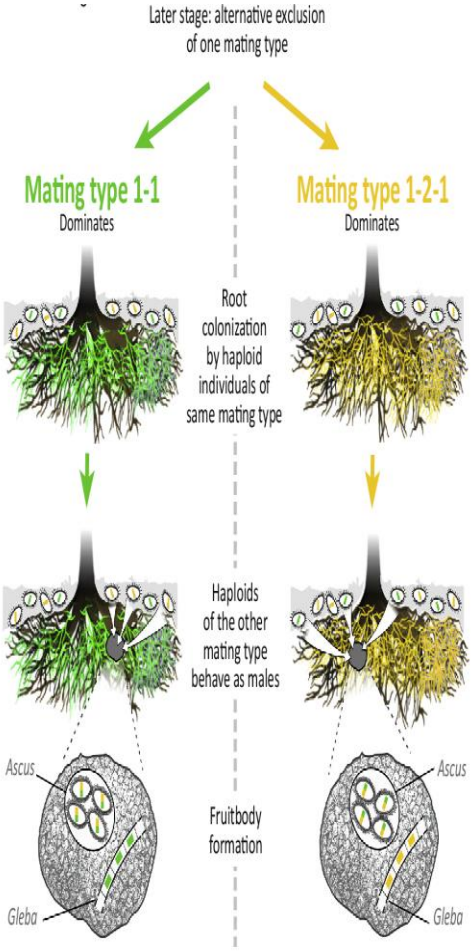
- ***Natural cycle of truffles: -***

The life cycle of the black truffle (Tuber melanosporum) includes a mating before sporulation: although the species is hermaphroditic, mating turns out to involve parents with very different features that mostly behave as male or female only, suggesting that this species undergoes forced dioecism.

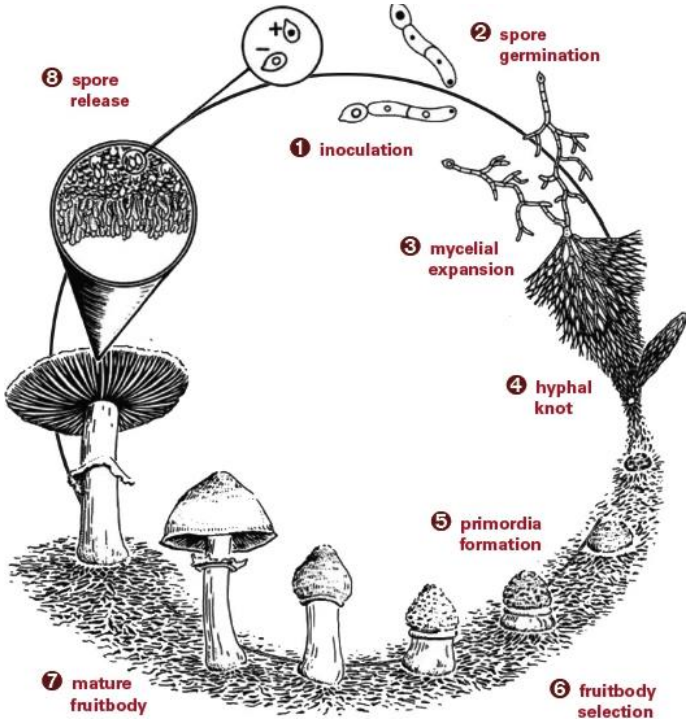


Dynamics and reproduction of truffle populations





- ***<u>Natural cycle of mushrooms: -</u>***



The mushroom life cycle remains largely invisible to most mushroom hunters; not so to cultivators. The mushroom cultivator follows the path of the mushroom life cycle. Fruit-bodies form only at the completion of the mushroom life cycle and for most species, occur but for a few days, then disappear.

Inoculation: Spores alight upon a growth medium (or substrate). If conditions are favorable, spores will germinate.

Spore germination: Fine fungal filaments known as hyphae grow from the spores. Compatible hyphae mate to create fertile mycelium.

Mycelial expansion: Developing mycelium breaks down organic matter and absorbs nutrients from its surroundings. During this stage of growth, mycelium expands at an exponential rate. In its environment, mycelium encounters many competitors and predators which it repels with an amazing array of protective enzymes and compounds. In this sense, the mycelium is the immune system of the mushroom.

Hyphal knot: Mycelium condenses into hyphal knots, which then develop into "primordia" or baby mushrooms.

Primordia formation: The mushroom organism produces an amazing array of enzymes and optimizes the constituents of both the mycelium and the developing fruit-body. Host Defense harvests during this peak stage of growth to capture an abundant constituent profile including polysaccharides (beta glucans, arabinoxylanes), glycoproteins, ergosterols, triterpenoids and other myco-nutrients.

Fruit-body selection: From thousands of primordia, the growing organism selects the most promising few to develop into mature fruit-bodies.

Mature fruit-body: The organism channels all of its energy and nutrients to develop the fruit-body, which will then produce spores. Spore generation is the sexual reproduction phase of the mushroom life cycle.

Spore release: The fruit-body releases spores into the environment for propagation. Those that land on a favorable substrate (or growth medium) can germinate, beginning the life cycle anew!

- ***Main types of truffles: -***
- ***Black truffle: -***

The "black truffle" or "black Périgord truffle" *Tuber melanosporum* is named after the Périgord region in France and grows only with oak. Specimens can be found in late autumn and winter, reaching 7 cm in diameter and weighing up to 100 grams.

The black truffles are found in the forests of Périgord, France, have been highly regarded and their collection and cultivation is an important industry. Traditionally hunted with pigs, they are now mainly found by dogs, which can be trained to point for truffles and have the distinct advantage of not being truffle eaters. Black truffle cultivation has been somewhat successful since the late 20th cent.; it requires the inoculation of the roots of a seedling of its host plants, oak, hazel, and other deciduous trees, with fungal spores. Tuber melanosporum (the Black Périgord truffle) only grows on chalky soils that are rich in calcium, with an optimal pH of between 7.5 and 8.5. Whatever the type of soil it must be both crumbly and stony to ensure a good drainage and to allow the mycelium of the fungi to dissipate freely.

- ***White truffle: -***

The white truffles are harvested primarily in central and N. Italy as well as in parts of S France, Croatia, and Slovenia, is more expensive and has not been successfully cultivated. The "white truffle" or *Alba*

madonna or *Tuber magnatum* comes from the Montferrat and Langhe areas of the Piedmont region in northern Italy and in the countryside around the city of Alba. It is also found in Croatia, on the Istria peninsula in the Motovun forest alongside Mirna river. They grow with oak, hazel, poplar and beech trees, and fruit in autumn. They can reach 12 cm diameter and 500 grams, though are usually much smaller. The flesh is pale cream or brown with white marbling.

Tuber magnatum is the high-value white truffle or trifola d'Alba Madonna ("Truffle of the White Madonna" in Italian) is found mainly in the Langhe and Montferrat areas of Italy of the Piedmont region in northern Italy, and most famously, in the countryside around the cities of Alba and Asti. Large percentage of Italy's white truffles also come from Molise.

Whitish truffle: -

The "whitish truffle" (Tuber borchii) is a similar species found in Tuscany, Abruzzo, Romagna, Umbria, the Marche, and Molise. It is not as aromatic as those from Piedmont, although those from Città di Castello come quite close.

- ***Other types of truffles: -***

Besides the well-known white and black truffles, the summer, or burgundy truffle, *T. aestivum,* a black truffle widely found in Europe, is most often associated with beech trees and is also prized for culinary use. *T. indicum,* a black truffle exported from China, where it grows on pine and chestnut roots, is regarded as inferior to the Périgord and summer truffles. The tasty Oregon white truffle, *T. oregonense,* grows on the roots of the Douglas fir tree, which is dependent upon the fungus for its mineral nutrition. Truffles are widespread in distribution and are found in a wide variety of habitats.

- ***Main types of mushrooms: -***

1. Amanita mushrooms: -

Amanita Muscaria or fly agaric is a psychoactive fungus that attracts and kills houseflies. The genus Amanita has about 600 species, including some of the most toxic ones.

2. Beech mushroom: -

Beech mushrooms are also called Clamshell mushrooms, these mushrooms have caps that are brown and a crunchy, but sweet and nutty flavor. However, this only applies when they are cooked, which is the best way to eat them. If they are eaten raw, you will notice a bitter taste that you're not likely to be fond of.

3. Black Trumpet mushrooms: -

Black Trumpet mushrooms usually bloom in the East and Midwest late in the summer, but grow all winter long in the West. Also known as the Horn of Plenty mushroom or the Trumpet of the Dead mushroom, they have a smoky, rich flavor and when dried, they are similar to the Black Truffle mushroom.

4. Brown cap boletus: -

Brown Cap Boletus mushrooms are edible and usually found at the edges of clearings and coniferous trees.

5. Button mushrooms: -

If you go to the supermarket and buy mushrooms, chances are that you're buying basic button mushrooms. It is also called white mushrooms or Agaricus bisporus; it is always harvested when they're very young, and they have a delicate, but earthy flavor. Moreover, since they are available all year long, they are very easy mushrooms to find. If you're looking for something to bake or stuff, try the older button mushrooms, which have a mild flavor and a firm texture.

6. Chanterelle mushrooms: -

If you cook with Chanterelle mushrooms, you should use them in a dry sauté because they have such a high water content that they will soon be cooking in the water anyway. Chanterelle mushrooms can be almost any color, but they are usually a golden brown. They smell and taste a little fruity and peppery, and they are perfect as a topping for entrees. Compared to many other types of mushrooms, they last a very long time if kept in the refrigerator – up to 10 days. Delicate in texture and flavor, they also go great with eggs.

7. Cremini mushroom: -

These are also sometimes called baby portobellos, and they look similar to the white button mushroom except for their size, which is slightly larger. The Cremini mushrooms are also a light shade of brown, instead of white. They have a mild flavor, and they can be used in place of white button mushrooms if that's what your recipe calls for.

8. Enoki mushrooms: -

Enoki mushrooms look a little like bean sprouts with their small caps, white color, and long stems. Popular in Asian dishes, you can buy these mushrooms either canned or fresh, and there is a lot of flavor to them. They are a crispy type of mushroom, so they go great in many salads and soups. Native to Japan, once you try Enoki mushrooms you are guaranteed to come back for more.

9. Green amanita: -

Green amanita is also known as the Death-cap Mushroom, contain poison throughout the cap, gills, stem, and spores.

10. Hedge mushrooms: -

Hedge mushroom is also known as the Sweet Tooth mushroom; its smell & taste is sweet, unless it is an older mushroom, in which case it may taste a little bitter. The Hedgehog mushroom tastes a lot like the Chanterelle mushroom and grows hardily in the winter months on the West Coast. It also has a meaty, nutty, and crunchy taste.

11. Hen of the woods mushrooms: -

In Japan, these mushrooms are also called maitake mushrooms, and they have a lot of flavors packed into them. Found growing at the base of oak trees, Hen of the Woods mushrooms are used in both Japanese and Western dishes, and they are rich, earthy, and look similar to a flower. Perfect for stir-fry dishes and many types of soup, the mushrooms hold their shape well when cooked, making them a very attractive addition to many of your dishes.

12. Honey agaric mushrooms: -

Honey agaric mushroom is the world's largest living stretching mushroom (up to 10 square Km.) underground & weighing around as much as a blue whale. Only the tip or a small percentage of the mushroom can be seen above the ground.

13. Lactarius indigo: -

It's a blue mushroom that's not particularly common but can be widespread in the woods. It produces dark blue milk when cut.

14. King trumpet mushrooms: -

Sometimes called the King Brown mushroom or the French Horn mushroom, these are very thick and meaty mushrooms, and they are also quite large in size.

15. Milk mushroom: -

Milk mushrooms are the only mushroom species that are native and cultivated in India. They are medium to large in size, edible, and excellent sources of vitamins B2, E, and A, phosphorus, potassium, and selenium, and also contain calcium, vitamin C, iron, and zinc.

16. Morel mushrooms: -

Morel mushrooms are rather unattractive, but they are delicious mushrooms that come alive with flavor when you eat them. They are rather chewy and look similar to a honeycomb. They are also quite savory and are especially delicious when you sauté them in butter. Morel mushrooms can be very expensive, and once you try them you'll understand why.

17. Oyster mushrooms: -

Oyster mushrooms look dissimilar to most other types of mushrooms, but there is no need to be intimidated by them. They have a delicate, sweet flavor and are very affordable as well. The reason they are called Oyster mushrooms is that of their appearance, and they have an almost anise-like taste at certain times of the year. Simple to cook with, the Oyster mushroom can be used in a variety of dishes. They also come in colors such as grey, brown, and even a reddish color, and the younger they are, the more flavorful they are.

18. Porcini mushrooms: -

Porcini mushrooms are very meaty and flavorful, and they are often found in numerous Italian dishes. Much like sourdough, Porcini mushrooms have a flavor and taste that is creamy and nutty, and they are light brown in color. They are also sold either canned, dried, or fresh, but the dried mushrooms need to be soaked in hot water for at least 15 minutes before you cook them. In addition, Porcini mushrooms can get up to 10 inches across, so they get quite large at times.

19. Portobello mushrooms: -

When white button mushrooms fully mature, their caps grow outwards and they are called Portobello mushrooms. With its mild flavor and somewhat meaty texture, you can even use these types of mushrooms as a substitute for meat in many dishes. Some people consider them one of the tastiest mushrooms in existence, and they are especially yummy when you grill them.

20. Russula mushroom: -

Russula emetica, also known as Sickener, is poisonous when eaten raw or poorly cooked and can cause nausea and vomiting. These are followed by severe stomach pains and diarrhea.

21. Shiitake mushrooms: -

Growing mostly in areas such as Korea, China, and Japan, these mushrooms are naturally very commonly found in a variety of Asian dishes. Like Portobello mushrooms, Shiitake mushrooms are chewy and meaty, and they are frequently included to enhance various sauces and soups. They have a lot of flavor to them, and they can often be found in powder form, which you can look for if you can't find them fresh.

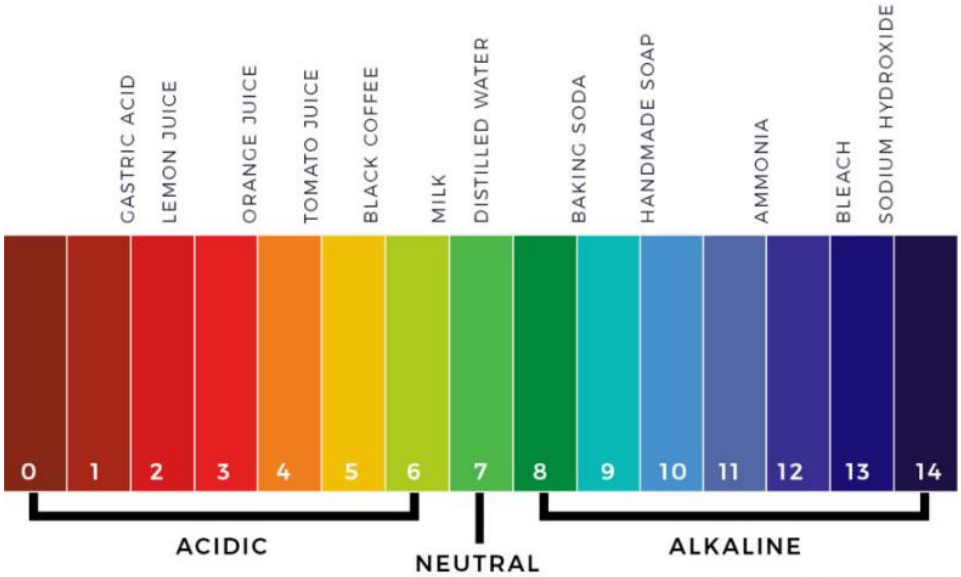
22. Toadstool mushrooms: -

It is so-called because they look like the spot where toads would sit, Toadstools are fungi widely believed to be inedible or toxic.

- ***pH of truffles: -*** is 8.7; it is alkaline because its pH is 8.7.
- ***pH of mushrooms: -*** is between 6 to 7; mushrooms are little acidic or neutral (basic).

pH is a measure of hydrogen ion concentration, a measure of the acidity or alkalinity of a solution. The pH scale usually ranges from 0 to 14. Aqueous solutions at 25°C with a pH less than 7 are acidic, while those with a pH greater than 7 are basic or alkaline & 7 is neutral; only aqueous solutions have pH levels, vegetable oil has

no pH value. Likewise, other oils such as animal and petrochemical oils also have no pH value. Fatty acids are organic molecules often found in foods, including vegetable oils.
The pH of pure water is 7. In general, water with a pH lower than 7 is considered acidic, and with a pH greater than 7 is considered alkaline. The normal range for pH in surface water systems is 6.5 to 8.5, and the pH range for groundwater systems is between 6 and 8.5. We can add normal water to reduce the acidity.
It is Sunnat of Prophet Muhammad (s.a.w) to mix acidic with Alkaline to make it neutral or less acidic that why He use eat dates with watermelon or cucumber or dry dates with little butter; so you can mix one acidic with alkaline; also it is Sunnat to drink honey mixed in water; also dates or raisins soaked in water over night & drink the syrup (sharbat). Remember do not soak dates & raisin together at one time; soak at separate time & drink.



- ***Calories of truffle: -*** 100 grams of truffle gives 91 calories.
- ***Calories of mushrooms: -*** 100 grams of mushroom gives 15 to 22 calories (depending on the type of mushroom).
- ***Glycemic index & Glycemic load of truffle: -***

Glycemic index of 4.5 grams (1 piece) of raw truffle is 45 & glycemic load is 0.1.

- ***Glycemic index & Glycemic load of mushrooms: -***

Glycemic index of 70 grams is 10–15 and a Glycemic load of less 1.
Both have a low glycemic index & load & suitable for diabetes patient & help in controlling blood glucose.

A food is considered to have a low Glycemic index (GI) if it is 55 or less; mid-range GI if 56 to 69 & high GI if 70 or more. *Glycemic index* is a number. It gives you an idea about how fast your body converts the carbs in a food into glucose.
A low Glycemic load (GL) is between 1 and 10; a moderate GL is 11 to 19; and a high GL is 20 or higher. For those with diabetes, you want your diet to have GL values as low as possible.
The *glycemic load* (GL) of food is a number that estimates how much the food will raise a person's blood glucose level after eating it. *Glycemic load* accounts for how much carbohydrate is in the food and how much each gram of carbohydrate in the food raises blood glucose levels.

- ***Truffle oil: -***

Truffle oil is a flavorful type of oil that is often drizzled over pizza, pasta, risotto or vegetables and is enjoyed for its rich taste and extensive health benefits.
When discussing truffle oil, however, it's important to distinguish between the real and synthetic stuff. Real truffle oil is made by adding edible truffles to an oil base and allowing the flavors to infuse over several days.

Ensuring you're getting real truffle oil can help maximize the health benefits of your dishes while getting a more authentic truffle flavor. Synthetic truffle oil, on the other hand, is what's mostly found on the market. It's produced by adding a chemical called 2,4-dithiapentane to oil, which mimics the taste and aroma of truffles.
Truffle oil ingredients may vary, but it is usually made using olive oil as a base. However, some truffle oil manufacturers may use other types of oil, such as canola oil or grapeseed oil instead, diminishing many of the potential health benefits of truffle oil.
So what is so special about truffles? Aside from their high price tag, truffles are considered a delicacy due to their intense aroma and ability to punch up the flavor of just about any dish. Plus, they're loaded with health benefits. Much like other types of fungi, such as mushrooms, truffles are loaded with antioxidants and flavonoids that can fight disease and boost overall health. Truffle oil is widely used in food preparation, often as salad dressings, mixed in with pasta sauces, on pizza, blended with eggs, topping chicken or fish, and even as a flavorful addition to popcorn or other snacks.

- ***Mushroom oil: -***

Mushroom oil can be made from packaged, dried mushrooms such as porcini and shiitake.

- ***Health benefits of truffle oil: -***

Promotes Heart Health, Aids in Weight Loss, Preserves Brain Function, Fights Cancer Development, Keeps Skin Glowing, Regulates Blood Sugar, lower cholesterol, reduce the risk of diabetes, improve circulation, decrease inflammation, boost antioxidant levels, and strengthen the immune system etc.
Health benefits of mushroom oil: -
Promotes heart health, weight loss, increase immunity, anti-cancer, anti diabetic, anti-oxidant etc.

- ***Health benefits of mushroom oil: -***

Mushroom oil is not abundantly available though it has a lot of benefits like boost immune system, reduces inflammation, protects heart from diseases & is anti-cancer etc.

- ***Gross health benefits of truffle: -***

It is rich with antioxidant compounds that helps fight free radicles & thus prevents cancer, heart diseases, diabetes, colon cancer, breast cancer, cervical cancer etc; it reduces inflammation & improves immunity; helpful in chronic diseases; it is anti tumour, hepato-protective; reduces cholesterol & it is immune-modulatory & have aphrodisiac effect; anti-microbial etc.

- ***Gross health benefits of mushrooms: -***

Boost the immune system; increases strength; helps in weight loss; prevent heart diseases; reduces inflammation; has anti-cancer properties; good for skin, nails & hair etc.

- ***Clinical pharmacology of truffle: -***

One test tube study showed that extract from desert truffles inhibited growth of staphylococcus aureus by up to 60% (these bacteria can cause wide range of diseases) & also decreased the growth of bacteria pseudomonas aeruginosa.
Both white & black truffles have anti-cancer properties & exhibit cervical, breast & colon cancers. Both have anti-inflammatory properties & thus block the inflammatory enzymes during inflammation in the body; both truffles reduce free radicle formation in the body thus are anti-cancer, anti-diabetic, anti-autoimmune disease; It is a great source of nutrition due vitamin, minerals, amino acids present in it.

- ***Clinical pharmacology of mushrooms: -***

Bioactive compounds and extracts from medicinal mushrooms showed mainly anti-allergic, antibacterial, antidepressant, antifungal, anti-inflammatory, antioxidant, antiviral, cardio-protective, hepatoprotective, neuroprotective, cytotoxic, hypotensive, and immunomodulatory activities. Mushrooms have various bioactive compounds, which have anticancer, antibacterial, antifungal, antiviral, antioxidant, and anti-inflammatory compounds. Researchers from Johns Hopkins University have recommended that psilocybin, the active

compound in hallucinogenic mushrooms, be reclassified for medical use, potentially paving the way for the psychedelic drug to one-day treat depression and anxiety and help people stop smoking. Hallucinogenic mushrooms are also called as magic mushrooms are wild or cultivated mushrooms that contain psilocybin, a naturally-occurring psychoactive and hallucinogenic compound. Psilocybin is considered one of the most well-known psychedelics, according to the Substance Abuse and Mental Health Services Administrations.


Magic mushrooms (Psilocybin mushrooms, commonly known as magic mushrooms or shrooms.

- ***Modern uses of truffle: -***

Truffles can be added in pickles, gravy, soups, salad, omelette, pasta, rice, saucer, chicken, fish, meat, can be mix with virgin olive oil & eaten or cooked with other dishes etc; one should clean the truffles properly before use; it should not be boiled on high flame because its nutrition gets lost; cut off any bad spots if present on truffle, brush off the dirt, rinse gently before use & blot it dry.

It can be kept in freeze for few days avoid keeping it for long in freeze. It should be eaten in small quantity only. Beware of artificial truffles always use natural only; truffles get rotten quickly.

Truffles should be grated or sliced with a slicer directly on to food and into sauces or soups, just before eating. They should not be cooked, as the heat will damage the flavour and aroma and they work well with chicken, fish, souffles, omelettes, pasta and risottos. Alternatively, you can make truffle butter by finely grating a fresh truffle and adding it to softened unsalted butter. You can spread truffle butter on crackers or bread, or have it with a baked potato.

- ***Modern uses of mushrooms: -***

Lightly rinse the mushrooms with normal water and pat dry with paper towels. Don't soak the mushrooms because they absorb water like little sponges, mushrooms won't brown nicely when cooked if they are full of water; then use a damp paper towel or a soft mushroom brush to wipe each mushroom, one at a time, to remove any dirt. Then cut a thin slice off the bottom of each stem and cut the mushrooms in half from stem to tip & rinse in normal water again, to remove any dirt and insects; again to clean sliced mushrooms, give them a shake in a colander to loosen any dirt, then give them a quick rinse just before you're ready to cook. Dry them off with paper towels or a clean tea towel always before cooking. After cleaning mushrooms, trim thin slices from the ends of the stems.

Mushrooms are fresh if they are firm, plump, and free from bruises with no visible moisture on the outside. Avoid slimy or spotted mushrooms. For white mushrooms, also called button mushrooms, the gills on the underside should be tightly closed.

Store mushrooms (except morels) unwashed in the refrigerator for up to two days in a paper bag or in the original packaging because they need to breathe, mushrooms shouldn't be stored in a plastic bag. To store morel mushrooms, clean and wrap mushrooms loosely in damp paper towels or damp clean cotton cloth, and place the bundle in a bowl. Store in the refrigerator for up to three days, keeping towels damp so the mushrooms don't dry out.

Mushrooms can be used as & in stuffing; sandwiches, pizza, soups, gravy, broth, pickle, sauce etc.

Mushrooms have a distinctive flavor of their own that can be brought out with simple additions such as butter or olive oil. Mushrooms contain a lot of water, so they'll shrink considerably during cooking. Also be aware that they soak up fat readily, so always use quality butter or oil for cooking

Roast mushrooms to bring out their natural sweetness. Coat them in oil and roast in the oven at 400 degrees until well browned. Bread mushrooms, fry them in hot oil. Make sure you use a high quality oil suitable for frying. Stir fry sliced mushrooms with soy sauce and oil for a simple dish. Grill mushrooms in the summertime. Simply place the mushrooms directly on the grill pan and cook until browned. Experiment with marinades for extra flavor. Sauté them in a pan. This is one of the most common methods. Start with plenty of hot oil or butter and sauté until browned. You can spice up scrambled eggs by adding mushrooms and garlic. Mushrooms make an excellent addition to any omelette.

- ***Contents/constituents of truffle: -***

All contents may not present in all types of it, because there are many varieties of it according to geographical regions & content may differ a lot as per cultivation, soil, seed, climate etc.

Aroma of it can range from mild to intense & vary from garlicky, pungent & dusty like; its aroma can be due to these compounds 2-methylbutanal, 3-methylbutanal, dimethyl-disulfide (DMDS); dimethyl-sulfide (DMS); 2,4-dithiapentane, tuberoside & many phytosterols.

72% water; little fats 0.06%, protein 8.6% (all 9 essential amino acids), crude fiber 7.6%, phosphorus, calcium, magnesium, potassium, sodium, iron, zinc, copper, folate, carbohydrate, sulfur, chlorine, silicon, selenium, vitamin B1, B2, B3, B5, B6, B12, A, D, E, C, K; lycopene, gallic acid, homogentisic acid; saturated & unsaturated fatty acids, omega 3 & 6 fatty acids; little natural sugar; choline, betaine, fluoride, beta carotene, ergosterol, anandamide, terpenoid, oleic acid, 2-3 butanedione, ethylbutarate etc; it has no fructose, lactose & gluten; it is under research to know more chemical compounds present in it. And all above content may not be present in all types of mushrooms due to difference in geographical region, climatic condition, rain fall etc.

A good quality of truffle contains little amount of amino acids mentioned in table below: -

- ***Contents/constituents of mushrooms: -***

Raw brown mushrooms are 92% water, 4% carbohydrates, 2% protein and less than 1% fat. In a 100 gram (3.5 ounce) amount, raw mushrooms provide 22 calories and are a rich source (20% or more of the Daily Value, DV) of B vitamins, such as B1, B2, B3, B6, B9, vitamin D, selenium (37% DV) and copper (25% DV), and a moderate source (10-19% DV) of phosphorus, zinc, magnesium, manganese, iron, calcium, sulfur, potassium & mild sodium. They have minimal or no vitamin C. Alanine, proline, serine and valine, linoleic and palmitic acid, oleic acid, stearic acid, ergosterol, 1-Octen-3-ol, 1-Octen-3-one, 3-Octanol, 3-Octanone, Octanol, amatoxin, orellanine, coprine, muscarine, muscimol, choline, psilocybin, psilocin, lampterol, agaritin, gyromitrin, ibotenic acid, benzaldehyde, 3-heptanone, isovaleric aldehyde, acetaldehyde, acetic acid, isobutyric acid, isovaleric acid and n-butyric acids. And all above content may not be present in all types of mushrooms due to difference in geographical region, climatic condition, rain fall etc.

The above ingredients are based on scientific study, means these has been identified, known & learnt by modern science, it does not mean that it contains only these ingredients, there may be many more ingredients which are yet to be discovered, learnt & known by modern science. The details given below are based on natural ingredients found in truffles and not synthetically prepared.

Each contents of truffles & mushrooms are explained separately below: -

- ***2-methylbutanel: -***

2-Methylbutanal belongs to the class of organic compounds known as short-chain aldehydes. It is a methylbutanal in which the methyl substituent is at position 2. It has a role as a volatile oil component, a plant metabolite and a Saccharomyces cerevisiae metabolite. It is a 2-methyl-branched fatty aldehyde and a methylbutanal. These are an aldehyde with a chain length containing between 2 and 5 carbon atoms. It is water soluble and is extremely weak acidic (essentially neutral) compound (based on its pKa). 2-Methylbutanal has been detected in multiple biofluids, such as feces and saliva. Within the cell, 2-methylbutanal is primarily

located in the cytoplasm. It exists in all eukaryotes, ranging from yeast to humans. 2-Methylbutanal has been linked to the inborn metabolic disorders including celiac disease.
It is also called as 2-Methylbutyraldehyde; it is also present in (as a flavor compound) in barley crystal malt, baked potato, whole milk powder.

- ***3-methylbutanal: -***

3-Methylbutanal, also known as isovaleraldehyde or iso-C4H9CHO, belongs to the class of organic compounds known as alpha-hydrogen aldehydes. These are aldehydes with the general formula HC(H)(R)C(=O)H, where R is an organyl group. It is butanal substituted by a methyl group at position 3. It exists as solid, water soluble and an extremely weak acidic (essentially neutral) compound (based on its pKa). 3-Methylbutanal has been detected in most biofluids, including feces, cerebrospinal fluid, saliva, and blood. It exists in all eukaryotes, ranging from yeast to humans. 3-Methylbutanal is an aldehydic, chocolate, and ethereal tasting compound that can be found in a number of food items such as kombu, allspice, carrot, and brazil nut. This makes 3-methylbutanal a potential biomarker for the consumption of these food products. It is found to be associated with the diseases known as hepatic encephalopathy & has also been linked to the inborn metabolic disorders including celiac disease. It occurs as a volatile constituent in olives. It has a role as a flavouring agent, a plant metabolite, a volatile oil component and a Saccharomyces cerevisiae metabolite.

- ***Dimethyl-disulfide: -***

Dimethyldisulfide, also known as 2, 3-dithiabutane or sulfa-hitech; it belongs to the class of organic compounds known as dialkyldisulfides. These are organic compounds containing a disulfide group R-SS-R' where R and R' are both alkyl groups. Dimethyldisulfide has been detected in multiple biofluids, such as saliva, feces, and urine. It is a cabbage, citrus, and earthy tasting compound that can be also found in a number of food items such as cereals and cereal products, pulses, wild leek, and parsley. This makes dimethyldisulfide a potential biomarker for the consumption of these food products. It is an organic disulfide that is methane in which one of the hydrogens has been replaced by a methyldisulfanyl group. It has a role as a xenobiotic metabolite. It appears as a colorless oily liquid with a garlic-like odor. It is denser than water and slightly soluble in water. Its vapors are heavier than air & may irritate skin and eyes.

- ***Dimethyl sulfide (DMS): -***

Dimethyl sulfide (DMS) or methylthiomethane is an organosulfur compound with the formula $(CH_3)_2S$. Dimethyl sulfide is a flammable liquid that boils at 37 °C (99 °F) and has a characteristic disagreeable odor. It is a component of the smell produced from cooking of certain vegetables, notably maize, cabbage, beetroot, and seafoods. It is also an indication of bacterial contamination in malt production and brewing. It is a breakdown product of dimethylsulfoniopropionate (DMSP), and is also produced by the bacterial metabolism of methanethiol. DMS originates primarily from DMSP, a major secondary metabolite in some marine algae. DMS is the most abundant biological sulfur compound emitted to the atmosphere. It has a characteristic smell commonly described as cabbage-like. DMDS is used as a food additive in onion, garlic, cheese, meats, soups, savory flavors, and fruit flavors. Industrially, DMDS is used in oil refineries as a sulfiding agent. DMDS is also an effective soil fumigant in agriculture, registered in many states in the U.S. as well as globally.

- ***2,4-Dithiapentane: -***

2,4-Dithiapentane is found as an aromatic component in some truffle varietals. It is the dimethyldithioacetal of formaldehyde. It is an organosulfur compound. It is a colorless liquid with a strong odor. The odor of 2,4-dithiapentane in white truffles is mild; but in pure form it smells strongly like freshly prepared mustard. It would be nice to think that commercial products such as truffle oil, butter, and puree contain the natural substance; but most such products contain synthetic 2,4-dithiapentane. It is also present in truffle oil. Bis-(methylthio) methane, also known as 2, 4-dithiapentane or bis(methylsulfanyl)methane, belongs to the class of organic compounds known as dithioacetals. Dithioacetals are compounds containing a dithioacetal functional

group with the general structure R2C(SR')2. Bis-(methylthio)methane has been primarily detected in feces. Within the cell, bis-(methylthio)methane is primarily located in the cytoplasm. Bis-(methylthio)methane exists in all eukaryotes, ranging from yeast to humans. Bis-(methylthio)methane is a cheese, garlic, and green tasting compound that can be found in a number of food items such as fats and oils, milk and milk products, mushrooms, and crustaceans. This makes bis-(methylthio)methane a potential biomarker for the consumption of these food products.

- ***Tuberoside: -***

Tuberoside belongs to the class of organic compounds known as steroidal glycosides. These are sterol lipids containing a carbohydrate moiety glycosidically linked to the steroid skeleton. Tuberoside exists as a solid and is considered to be practically insoluble (in water) and relatively neutral. Tuberoside has been found in human hepatic tissue, and has also been primarily detected in urine. Within the cell, tuberoside is primarily located in the membrane (predicted from logP) and cytoplasm. Outside of the human body, tuberoside can be found in mushrooms. This makes tuberoside a potential biomarker for the consumption of this food product. It is of many types.

- ***1-Octen-3-ol or octenol: -***

1-Octen-3-ol, octenol for short and also known as mushroom alcohol; it is a chemical that attracts biting insects such as mosquitoes. It is contained in human breath and sweat, and it was once believed that insect repellent DEET worked by blocking the insects' octenol odorant receptors. Recent evidence in Anopheles gambiae and Culex quequinfasciatius mosquitoes suggest DEET reduces the volatility of 1-octen-3-ol which can result in a reduction in human attraction. 1-Octen-3-ol is a secondary alcohol derived from 1-octene. It exists in the form of two enantiomers, (*R*)-(–)-1-octen-3-ol and (*S*)-(+)-1-octen-3-ol. Octenol is produced by several plants and fungi, including edible mushrooms and Lemon balm. Octenol is formed during oxidative breakdown of linoleic acid. Octenol is used, sometimes in combination with carbon dioxide, to attract insects in order to kill them with certain electronic devices. The name 'mushroom alcohol' is used because octenol is the main flavour component of mushrooms. Octenol is approved by the U.S. Food and Drug Administration as a food additive.

- ***3-Octanol: -***

(S)-3-Octanol, also known as 1-ethylhexanol or 3-octanol, belongs to the class of organic compounds known as fatty alcohols. These are aliphatic alcohols consisting of a chain of least six carbon atoms. Thus, (S)-3-octanol is considered to be a fatty alcohol lipid molecule (S)-3-Octanol is slightly soluble (in water) and an extremely weak acidic (essentially neutral) compound (based on its pKa) (S)-3-Octanol has been detected in multiple biofluids, such as feces and urine. Within the cell, (S)-3-octanol is primarily located in the cytoplasm. Octan-3-ol is an aliphatic alcohol that is octane substituted by a hydroxy group at position 3. It has a role as a metabolite. It is an aliphatic alcohol and an octanol.

- ***3-octanone: -***

3-octanone is a dialkyl ketone that is octane in which the two methylene protons at position 3 have been replaced by an oxo group. It has a role as a human urinary metabolite, an insect attractant, a fungal metabolite, an anti-feedant, a plant metabolite and a biomarker. It derives from a hydride of an octane. It also known as 3-oxooctane or amyl ethyl ketone, belongs to the class of organic compounds known as ketones. These are organic compounds in which a carbonyl group is bonded to two carbon atoms R2C=O (neither R may be a hydrogen atom). Ketones that have one or more alpha-hydrogen atoms undergo keto-enol tautomerization, the tautomer being an enol.

- ***Amatoxin: -***

Amatoxin is the collective name of a subgroup of at least eight related toxic compounds found in several genera of poisonous mushrooms, most notably the death cap (Amanita phalloides) and several other members of the

genus Amanita, as well as some Conocybe, Galerina and Lepiota mushroom species. Amatoxins are lethal in even small doses, as little as half a mushroom. Unlike many ingested poisons, they cannot be destroyed by heat without destroying the mushrooms beyond edibility first, so cooking the poisonous mushrooms does not diminish their lethality. Amatoxin containing mushrooms are a rare but significant cause of acute fulminant liver failure. It may also cause kidney failure & severe skin irritation.

- ***Muscimol: -***

Muscimol (also known as agarin or pantherine) is one of the principal psychoactive constituents of Amanita muscaria and related species of mushroom. Muscimol is a potent, selective agonist for the GABAA receptors and displays sedative-hypnotic, depressant and hallucinogenic psychoactivity. Muscimol is produced in the mushrooms Amanita muscaria (fly agaric) and Amanita pantherina, along with muscarine (which is present in trace amounts and it is not active), muscazone, and ibotenic acid. The effects of the muscimol begin 30–120 minutes after consumption and last for 5–10 hours. Muscimol poisoning is termed as "pantherine–muscaria" syndrome in humans. These include euphoria, dream-like (lucid) state of mind, out-of-body experiences and synesthesia. Negative effects include mild to moderate nausea, stomach discomfort, increased salivation and muscle twitching or tremors. In large doses strong dissociation or delirium may be felt. Treatment is symptomatic and supportive.

- ***Orellanine: -***

Orellanine or orellanin is a mycotoxin found in a group of mushrooms known as the Orellani of the family Cortinariaceae. Structurally, it is a bipyridine N-oxide compound somewhat related to the herbicide diquat. Orellanine is a nephrotoxic toxin produced by some mushroom species of the Cortinarius genus, typically found in Europe and North America. The nephrotoxicity of Cortinarius orellanus is well known and was first recognized in the 1950s when this mushroom was identified as the cause of a mass poisoning in Poland. Typically, onset of symptoms is delayed for 1-2 weeks after ingestion. Some patients suffer mild gastrointestinal discomfort in the latency period before developing signs of renal impairment due to severe interstitial nephritis, acute focal tubular damage, and interstitial fibrosis. There is no specific antidote to orellanine poisoning.

- ***Coprine: -***

Coprine is a mycotoxin. It was first isolated from common incap (*Coprinopsis atramentaria*). It occurs in mushrooms in the genera Coprinopsis and Coprinus, with the most popular example being the brawny bolete (*Imperator torsus*). When combined with the consumption of alcohol, it causes "Coprinus syndrome". It inhibits the enzyme acetaldehyde dehydrogenase, which is involved in the metabolism of alcohol. This inhibition leads to a buildup of acetaldehyde, causing an alcohol flush reaction. Because of this, the mushroom is commonly referred to as Tippler's Bane**.** Symptoms of coprine poisoning include facial reddening/flushing, nausea, vomiting, malaise, agitation, palpitations, tingling in limbs, and sometimes headache and excessive salivation. This can be described as the alcohol flush reaction. Symptoms typically arise five to ten minutes after consumption of alcohol. If no more alcohol is consumed, the symptoms will generally subside over two to three hours, and symptom severity is proportional to the amount of alcohol consumed. Consumption of alcohol can induce these symptoms for up to 5 days after ingesting coprine. Interestingly, symptoms of coprine poisoning do not appear when the mushroom is ingested raw, but only when the mushroom is cooked. Treatment is symptomatic and supportive and remission takes place in a few hours.

- ***Muscarine: -***

Muscarine, L-(+)-muscarine, or muscarin is a natural product found in certain mushrooms, particularly in Inocybe and Clitocybe species, such as the deadly C. dealbata. Mushrooms in the genera Entoloma and Mycena have also been found to contain levels of muscarine which can be dangerous if ingested. Muscarine mimics the function of the natural neurotransmitter acetylcholine in the muscarinic part of

the cholinergic nervous system. Muscarine mimics the action of the neurotransmitter acetylcholine by agonising muscarinic acetylcholine receptors. These receptors were named after muscarine, to differentiate them from the other acetylcholine receptors (nicotinic receptors), which are comparatively unresponsive to muscarine. There are 5 different types of muscarinic receptors; M1, M2, M3, M4 and M5. Most tissues express a mixture of subtypes. The M2 and M3 subtypes mediate muscarinic responses at peripheral autonomic tissues. M1 and M4 subtypes are more abundant in brain and autonomic ganglia. The odd numbered receptors, M1, M3 and M5, interact with Gq proteins to stimulate phosphoinositide hydrolysis and the release of intracellular calcium. Conversely, the even numbered receptors, M2 and M4, interact with Gi proteins to inhibit adenylyl cyclase, which results in a decrease of intracellular concentration of cyclic adenosine monophosphate (cAMP). Most agonists for muscarine receptors are not selective for subtypes. Muscarinic receptors also signal via other pathways, for instance via G beta-gamma complex modulation of potassium channels. This allows muscarine to modulate cellular excitability via the membrane potential.

Muscarine poisoning is characterized by miosis, blurred vision, increased salivation, excessive sweating, lacrimation, bronchial secretions, bronchoconstriction, bradycardia, abdominal cramping, increased gastric acid secretion, diarrhea and polyuria, headache, nausea, vomiting, and constriction of the pharynx If muscarine reaches the brain it can cause tremor, convulsions and hypothermia. Cardiac ventricles contain muscarinic receptors that mediate a decrease in the force of contractions leading to a lower blood pressure. If muscarine is administered intravenously, muscarine can trigger acute circulatory failure with cardiac arrest. Anti-muscarinics such as atropine can be used as an antidote to muscarine.

- ***Psilocybin & psilocin: -***

Mushrooms containing psilocybin are small and usually brown or tan. Psilocybin is a hallucinogenic substance people ingest from certain types of mushroom that grow in regions of Europe, South America, Mexico, and the United States. The mushrooms containing psilocybin are known as magic mushrooms. Psilocybin is a hallucinogen that works by activating serotonin receptors, most often in the prefrontal cortex. This part of the brain affects mood, cognition, and perception. After the ingestion and absorption of psilocybin, the body converts it to psilocyn. The hallucinogenic effects of psilocybin usually occur within 30 minutes of ingestion and last between 4 and 6 hours. In some individuals, the changes in sensory perception and thought patterns can last for several days.

Possible effects of psilocybin include euphoria, peacefulness, spiritual awakening, quickly changing emotions, derealization, or the feeling that your surroundings are not real depersonalization, or a dream-like sense of being disengaged from your surroundings, distorted thinking, visual alteration and distortion, such as halos of light and vivid colors, dilated pupils, dizziness, drowsiness, impaired concentration, muscle weakness, lack of coordination, unusual body sensations, nausea, paranoia, confusion, frightening hallucinations, vomiting & yawning. A mushroom which contains psilocybin is called as Psilocybin mushrooms & also commonly known as magic mushrooms or shrooms. The effects of psilocybin mushrooms come from psilocybin and psilocin. When psilocybin is ingested, it is broken down by the liver in a process called dephosphorylation. The resulting compound is called psilocin, which is responsible for the psychedelic effects. Hallucinogenic mushrooms' is the name commonly given to psychoactive fungi, containing hallucinogenic compounds, most commonly psilocybin and psilocin. Psilocin itself is also present in the mushroom, but in smaller amounts. Psilocybin and psilocin are both indolealkylamines and structurally similar to the neurotransmitter serotonin (5-hydroxytryptamine or 5-HT).

Psilocybin is also called as psilocybine, psilocibina, psilocybinum, psylosybiini; (CAS-number: 520-52-5) is 4-phosphoryloxy-NN-dimethyltryptamine. According to IUPAC, the fully systematic chemical name is [3-(2-dimethylaminoethyl)-1H-indol-4-yl] dihydrogen phosphate. Psilocybin is the dihydrogen phosphate of psilocin. Psilocybin is soluble in water, moderately soluble in methanol and ethanol, and insoluble in most organic

solvents. Psilocybin is a prodrug of psilocin, *in vivo* the molecule is metabolized into psilocin by dephosphorylation.

- ***Lampterol: -***

An anti-tumour factor, lampterol, $C_{15}H_{20}O_4$, has been isolated from the poisonous mushroom, *Lampteromyces japonicus* (KAWAM.) Sing. During the structural studies on lampterol, structures were proposed for illudin S, which was found to be identical with lampterol. The same conclusion was reached by independent chemical and spectroscopic data, and recently by X-ray analysis. The unique structure of illudin S (lampterol) gives rise to several rearrangement products.

- ***Agaritine: -***

Agaritine (AGT) is an aromatic, antiviral, hydrazine-derivative mycotoxin and IARC Group 3 carcinogen that occurs in mushroom species of the genus Agaricus. Agaritine is a naturally occurring phenylhydrazine derivative present in wild and cultivated Agaricus mushroom species, including the cultivated mushroom Agaricus bisporus. The highest amount of agaritine is found in the cap and gills of the mushrooms, and the lowest in the stem.

- ***Gyromitrin: -***

Gyromitrin is a toxin and carcinogen present in several members the fungal genus Gyromitra, *like* G. esculenta & many types of mushrooms. It is unstable and is easily hydrolyzed to the toxic compound monomethylhydrazine. Monomethylhydrazine acts on the central nervous system and interferes with the normal use and function of vitamin B6. Poisoning results in nausea, stomach cramps, and diarrhea, while severe poisoning can result in convulsions, jaundice, or even coma or death.

- ***Ibotenic acid: -***

Ibotenic acid or (*S*)-2-amino-2-(3-hydroxyisoxazol-5-yl) acetic acid, also referred to as ibotenate, is a chemical compound and psychoactive drug which occurs naturally in Amanita muscaria and related species of mushrooms typically found in the temperate and boreal regions of the northern hemisphere. It is a conformationally-restricted analogue of the neurotransmitter glutamate, and due to its structural similarity to this neurotransmitter, acts as a non-selective glutamate receptor agonist. Because of this, ibotenic acid can be a powerful neurotoxin, and is employed as a "brain-lesioning agent" through cranial injections in scientific research. Ibotenic acid is an agonist of glutamate receptors, specifically at both the N-methyl-D-aspartate, or NMDA, and trans-ACPD receptor sites in a multiple of systems in the central nervous system. Ibotenic neurotoxicity can be enhanced by glycine and blocked by dizocilpine. Dizocilpine acts as an uncompetitive antagonist at NMDA receptors.

Ibotenic acid toxicity comes from activation of the NMDA receptors. NMDA receptors are related to synaptic plasticity and work with metabotropic glutamate receptors to establish long term potentiation or LTP. The process of long term potentiation is believed to be related to the acquisition of information. The NMDA receptor functions properly by allowing Ca^{2+} ions to pass through after activation at the receptor site.

Symptoms associated with ibotenic acid are usually onset within 30–60 minutes and include a range of nervous system effects. The most common symptoms include, nausea, vomiting, and drowsiness. However, after the first hour symptoms begin to include confusion, euphoria, visual and auditory distortions, sensations of floating, and retrograde amnesia. Symptoms are slightly different for children, typically beginning after 30–180 minutes. Dominant symptoms in children include ataxia, obtundation, and lethargy. Seizures are occasionally reported, however, more commonly with children.

- ***Benzaldehyde: -***

Benzaldehyde (C_6H_5CHO) is an organic compound consisting of a benzene ring with a formyl substituent. It is the simplest aromatic aldehyde and one of the most industrially useful. It is a colorless liquid with a characteristic almond-like odour. The primary component of bitter almond oil, benzaldehyde can be extracted

from a number of other natural sources. Almonds, apricots, apples, and cherry kernels contain significant amounts of amygdalin. This glycoside breaks up under enzyme catalysis into benzaldehyde, hydrogen cyanide and two equivalents of glucose. Benzaldehyde contributes to the scent of oyster mushrooms (*Pleurotus ostreatus*). Breathing Benzaldehyde can irritate the nose and throat causing coughing and shortness of breath. Benzaldehyde rapidly metabolizes to Benzoic Acid in the skin, & irritates the skin and eyes, and repeated exposure can cause a skin rash to develop. Exposure can cause you to feel dizzy and lightheaded. Benzaldehyde was not considered a carcinogenic risk to humans. It is an aromatic aldehyde & used in cosmetics as a denaturant, a flavoring agent, and as a fragrance.

- ***3-heptanone***

3-heptanone is also known as aethylbutylketon or eptan-3-one & Heptan-3-one, belongs to the class of organic compounds known as ketones. These are organic compounds in which a carbonyl group is bonded to two carbon atoms R2C=O (neither R may be a hydrogen atom). Ketones that have one or more alpha-hydrogen atoms undergo keto-enol tautomerization, the tautomer being an enol. Thus, is considered to be an oxygenated hydrocarbon lipid molecule. exists as a liquid, slightly soluble (in water), and an extremely weak basic (essentially neutral) compound (based on its pKa). has been primarily detected in feces. Within the cell, is primarily located in the cytoplasm. can be converted into methadone. is a fatty, fruity, and green tasting compound that can be found in spearmint. This makes a potential biomarker for the consumption of this food product. It is a dialkyl ketone with butyl and ethyl as the two alkyl groups. It has a role as a biomarker and a metabolite. It is a seven carbon ketone. It is a colorless liquid with a "green odor," also described to have a fruity scent. It is often used as a perfume/fragrance, as a solvent for cellulose, nitrocellulose, or vinyl resins, and as a synthetic building block in the preparation of other organic molecules.

- ***Isovaleric aldehyde: -***

Isovaler aldehyde is an organic compound, it is also known as 3-methylbutanal, & has the formula $(CH_3)_2CHCH_2CHO$. It is an aldehyde, a colorless liquid at Standard temperature and pressure and found in low concentrations in many types of food. It is described as having a malty flavor and has been found in such foods as beer, cheese, coffee, chicken, fish, chocolate, olive oil, carrot, brazil nuts and tea.

- ***Acetaldehyde: -***

Acetaldehyde, also known as ethanal, belongs to the class of organic compounds known as short-chain aldehydes. These are an aldehyde with a chain length containing between 2 and 5 carbon atoms. Acetaldehyde exists as a solid, soluble (in water), and a very weakly acidic compound (based on its pKa). It is a widespread, naturally occurring, colorless and flammable liquid with a suffocating smell & found in various plants, ripe fruits, vegetables, cigarette smoke, gasoline and diesel exhaust. It is a major toxic metabolite & when anyone drinks alcohol, liver turns acetaldehyde into an acid but some acetaldehyde enters your blood, damaging the membranes and possibly causing scar tissue. It also leads to a hangover, and can result in a faster heartbeat, a headache or an upset stomach. It is removed from the body primarily by oxidation to acetate via a number of NAD-linked aldehyde dehydrogenase (ALDH) enzymes.

- ***Acetic acid: -***

Acetic acid systematically named ethanoic acid; it is a colourless liquid organic compound with the chemical formula CH_3COOH (also written as CH_3CO_2H, $C_2H_4O_2$, or $HC_2H_3O_2$). When undiluted, it is sometimes called glacial acetic acid. Acetic acid that contains a very low amount of water (less than 1%) is called anhydrous (water-free) acetic acid or glacial acetic acid. The main use of glacial acetic acid in cooking is in form of vinegar. It is generally used in cooking, making salads, and pickling and canning. Marinating meat in dilute acetic acid kills bacteria and tenderises the meat.

- ***Isobutyric acid: -***

Isobutyric acid is an organic chemical compound belongs to the class of organic compounds known as carboxylic acids; it has the chemical formula (CH3)2-CH-COOH. It is an isomer of butyric acid. It is also known as isobutyrate or iso-C3H7COOH, Carboxylic acids are compounds containing a carboxylic acid group with the formula -C(=O)OH. Isobutyric acid exists as a solid, soluble (in water), and a weakly acidic compound It's mainly used in the synthesis of isobutyric acid esters. It can also be used as edible flavor and in pharmaceutical. Another use is for production of the perfume ester.

- ***Isovaleric acid: -***

Isovaleric acid is an organic chemical compound with the chemical formula (CH3)2CHCH2COOH and is an isomer of the valeric acid. Isovaleric acid has been used to synthesize β-Hydroxy β-methylbutyric acid via microbial oxidation. This molecule in used as a dietary supplement for the pharmaceutical. Natural Isovaleric acid has a sweet, dairy, fermented, cheesy flavor and a strong odor. It is used as a food flavoring in a variety of foods and beverages. Isovaleric acid is a C5, branched-chain saturated fatty acid. It has a role as a plant metabolite and a mammalian metabolite. It is a short-chain fatty acid, a methylbutyric acid and a branched-chain saturated fatty acid. It is a conjugate acid of an isovalerate. It is a colorless liquid with a penetrating odor. It is slightly soluble in water. It is corrosive to metals and to tissue. It is also called as 3-Methylbutanoic acid or β-methylbutyric acid; it is a branched-chain alkyl carboxylic acid with the chemical formula $(CH_3)_2CHCH_2CO_2H$. It is classified as a short-chain fatty acid. Like other low-molecular-weight carboxylic acids, it has an unpleasant odor. The compound occurs naturally and can be found in many foods, such as cheese, soy milk, and apple juice. It has a strong pungent cheesy or sweaty smell.

- ***N-Butyric acid: -***

Butyric acid is a short-chain fatty acid. It is commonly present in our intestines, along with acetic acid and propionic acid. It is created in our intestines when the good bacteria in our intestine break down dietary fiber. It's also found in animal fats and vegetable oils, milk red meat, cheese, ghee, butter etc. It is present in more quantity in ghee & butter. It is good for our intestine & large intestines (colon) & help in preventing & healing of colon & intestinal diseases. It is also called as n-Butyric acid, butyric acid & butanoic acid.

- ***Choline: -***

It is water soluble vitamin & essential nutrient; it is a constituent of lecithin; it helps in many functions of the body.

Main sources of choline: -

It is present in watermelon, egg, peanut, fish, dairy products, wheat, beetroot, spinach, beans, whole grains, grapes etc.

Basic pharmacokinetics of choline (based on human intake in natural food products): -

Choline is mostly present in food in free form; it is absorbed in small intestine via transporter proteins & metabolized in liver; excessive choline is not stored but converted into phospholipids; it is changed into Trimethylamine in liver & is excreted in urine.

Basic clinical pharmacology of choline: -

It helps the nerves to develop signals. Our body makes some amount of choline, but should be consumed to avoid deficiency; it helps liver function, brain development, muscles movement, cell messenger system, DNA synthesis, nervous system, gall bladder function; it can be taken in pregnancy because it prevents neural tube defect. It aids in fats & cholesterol metabolism & prevent excessive fat building in liver.

- ***Crude fiber: -***

Crude fiber is a measure of the quantity of indigestible cellulose, pentosans, lignin, and other components of this type in present foods. It is the residue of plant materials remaining after solvent extraction followed by digestion with dilute acid and alkali. Crude fiber consists largely of cellulose (60-80%) and lignin (4-6%) plus some mineral matter. These Fibers are beneficial in treating or preventing constipation, hemorrhoids, diverticulosis, coronary heart diseases, and some type of cancer.

- ***Calcium: -***

It is natural essential mineral for the body, it is among the electrolytes of the body; its symbol is Ca & atomic no. 20.

Main sources of calcium: -

It is present in watermelon, quince, milk, banana, cheese, green leafy vegetables, soya beans, nuts, fish, meat, egg, bread, flour, yogurt, almonds, kale, soybean, spinach, cucumber etc.

Basic pharmacokinetics of calcium (based on human intake in natural food products): -

Calcium is absorbed in duodenum & upper jejunum (when calcium intake is low) by transcellular active transport process, this depends on action of calcitriol & intestinal vitamin D receptors & when calcium intake is high, absorbed by paracellular passive process throughout the length of small intestine by 3 major steps, entry across the brush border, intracellular diffusion via calcium-binding protein & extrusion; Vitamin D is necessary for absorption of calcium, also vitamin C, E, k, magnesium & exercise increases the absorption of calcium. Also the level of calcium is regulated by calcitonin released by thyroid gland it reduces calcium level in blood when it is excessive & increases the excretion of calcium via kidneys; Parathyroid hormones (PTH) released by parathyroid gland increases the blood level of calcium when body need it or calcium is less in blood & promotes reabsorption of it in kidneys (calcitonin & PTH both have opposite function). Intestines can absorb 500 to 600 mg of calcium at a time; it is mostly stored in bone tissues & teeth & excreted in stool & sweat & little in urine depended upon the level of it in blood. Also estrogen act on transport of blood calcium in bones thus women mostly suffer from osteoporosis after menopause.

Basic clinical pharmacology of calcium: -

Calcium acts on bone health, communication between brain & other parts of the body, muscles contraction, blood clotting; it is a co-factor for many enzymes, it relaxes the smooth muscles & blood vessels; it maintains heart rhythm, muscles function; it is more needed in childhood & deficiency of it in childhood may cause convulsions (seizure); Excessive level of it in blood is called as hypercalcemia & may lead to kidney stone formation, heart attack, stroke, loss of appetite, excessive urination, memory loss etc; its low level in blood is called as hypocalcemia & may lead to cramps in the body, weak bones, weak teeth, numbness, tingling etc.

Contraindication: -

Sarcoidosis, excessive level of calcium in blood, very severe constipation, kidney stones, increased activity of parathyroid gland etc. Hypersensitivity of calcium, severe cardiac diseases, hypercalcemia, hypercalciuria, severe kidney stones etc.

- ***Iron: -***

It is an essential mineral for our body; its symbol is Fe & atomic no. 26; it is an important component of haemoglobin (haemoglobin binds oxygen in lungs & supply it to whole body, it is oxygen carrier).

Main sources of iron: -

It is present in watermelon, quince, meat, dates, spinach, egg, nuts, dark leafy green vegetables, broccoli, pumpkin seeds, chicken, legumes, fish, banana, cabbage, kidney, almonds, cucumber etc.

Meat is the best source of iron; it provides Fe+2 directly which can be transported from intestine to blood steam through Fe+2 transporter ferroportin (this binds with transferring & delivered into tissues).

Basic pharmacokinetics of iron (based on human intake in natural food products): -

The absorption of iron is not known fully; about only 10% of iron taken in food is absorbed; it is absorbed in duodenum & upper jejunum mainly & at the end part of ileum; low pH is needed for its absorption, after absorption it get bind to transferring (each transferring can carry 2 atoms of iron); ceruloplasmin (protein) also helps in binding of iron; Hepcidin a hormone produced by liver is released when iron stores are full & inhibits iron transport & binding, thus reduces the absorption of iron; vitamin C & copper enhances iron absorption.

Storage of iron: -

Iron is stored in liver (in hepatocytes & kupffer's cells) kupffer's cells play an important role in recycling body iron, they ingest aged RBC liberate iron for it & reuse by breaking down haemoglobin. Little iron is stored in liver, heart, & kidneys in form of ferritin also little in bone marrow, spleen.

Excretion of iron: -

The body does not possess a physiological mechanism for regularly eliminating iron from the body because most of it is recycled by liver cells; iron is lost within cells, from skin & interior surface of the body (intestines, urine, breathe).

Basic clinical pharmacology of iron: -

It is an important component of Haemoglobin (haemoglobin bind oxygen in lungs & supply it to whole body); iron is beneficial for nails, hair, skin etc; it acts on blood production, its deficiency causes Anaemia (low haemoglobin level in blood) (this causes reduced in oxygen carrying capacity & supply of it); most of the iron is present in haemoglobin, it consists of one heme (iron), one protein chain (globin) this allows it to bind & load oxygen from the lungs & supply it to whole body.

Unbounded or free iron is highly destructive & dangerous it can trigger free radical activity which can cause cell death & destroy DNA.

- ***Copper: -***

It is an essential micronutrient mineral; its symbol is Cu & atomic no. 29; there are lot of health benefits of it; it is needed in little amount in the body.

Main sources of copper: -

It is present in watermelon, quince, spirulina (water-plant), nuts, seeds, lobster, leafy green vegetables, guava, grapes, green olive, kiwi, mango, pineapple, pomegranate, egg etc.

Basic pharmacokinetics of copper (based on human intake in natural food products): -

It is absorbed 30 to 50%; it is absorbed easily than other minerals, its absorption depends on the copper present in the body, when the intake of it is less, absorption is increased & when intake is more absorption is less, it is mainly absorbed in small intestines & little in stomach via carrier-mediated process; its absorption is influenced by amino acids, vitamin C & other dietary factors. After absorption it is bound primarily to albumin, peptide & amino acids & transported to liver. Copper is secreted into plasma as a complex with ceruloplasmin. It is mainly stored in liver little in brain, heart & kidneys; it is excreted mainly in bile & little in urine.

Basic clinical pharmacology of copper: -

Together with iron it enables the body to form RBC; it helps to maintain health of bones, blood vessels, nerves & immune system; it also acts on iron absorption, protein metabolism, growth of body, it acts also on development of brain, heart & other organ; it is needed by the body for making ATP, collagen. Excessive of it may cause Wilson's disease.

Deficiency of copper: -

It is very rare; but may cause cardiovascular disease, genetic defects, inflammation of optic nerve etc.

- ***Selenium: -***

It is an essential trace mineral; it is micro nutrient helpful to our body; its symbol is Se & atomic no. 34.

Main sources of selenium: -

It is present in watermelon, fish, nuts, beef, chicken, mushroom, egg, grains, garlic, grapes etc.

Basic pharmacokinetics of selenium (based on human intake in natural food products): -

It is mainly absorbed in duodenum & proximal jejunum by active transport process; Dietary selenium is in 2 forms organic (selenoimethionine) it is 90% absorbed & inorganic (selenite) it is 50% absorbed; after absorption it is send in liver via portal veins, liver turns it into selenite & then is bound with selenoproteins & send into blood stream, gets in RBC, muscles, tissues etc; it is not distributed evenly in the body, liver has more of it; Vitamin E & other vitamins increases its absorption & both work as an anti-oxidant. Natural selenium remains in the body for less than 24 hours; it is stored in amino acid in skeletal muscles, little in liver, kidneys & pancreas; it is primarily excreted in urine, stool & expired in air via lungs very little in sweat & semen.

Basic clinical pharmacology of selenium: -

It is important for many body functions, immune system, fertility (both male & female); it contributes in thyroid hormone metabolism, DNA synthesis; it protects the body from oxidative damages & infection, it is found in tissues, skeletal muscles; it helps testies & seminal vesicles in their function; it reduces the risk of miscarriages, liver disease, cancer, asthma, cardio vascular disease; deficiency of it causes pain in muscles & joints, weaken the hair, nails, white spots on nails are found etc.

- ***Zinc: -***

It is a trace mineral; symbol is Zn & atomic no. 30; it is necessary for human body as it plays vital role in health.

Main sources of zinc: -

It is present in watermelon, quince, meat, fish, legumes, beans, egg, dairy products, seeds, nuts, whole grains, cucumber etc.

Basic pharmacokinetics of zinc (based on human intake in natural food products): -

It is absorbed 20 to 40%, its absorption depends on its concentration & is absorbed in whole intestines (jejunum has high rate of its absorption) via carrier-mediated mechanism, it is released from food as free ions during digestion. Zinc from animal sources is easily absorbed comparing to plants sources. It is present in bile & pancreatic juices which is released in duodenum & is reused by the body this is called as endogenous zinc & zinc present is food sources is called as exogenous zinc. Its absorption depends on 2 proteins- Albumin & metallophinonein. Albumin enables zinc to be transported from plasma into enterocytes. It is stored in muscles, bones mainly & little in prostate, liver, kidneys, skin, brain, lungs, heart & pancreas. It is excreted in stools 80% & rest in urine & sweat. Metallophinonein binds to zinc to make it unavailable & excrete it in stools when zinc is excess in the body, & production of metallophinonein is reduced when zinc is less in the body to make zinc available for the body.

Basic clinical pharmacology of zinc: -

It is necessary for immune system, prevents skin diseases, heal skin diseases, helps stimulate activity of at least 100 different enzymes in the body; it is required in little amount in the body, but children, pregnant & old aged need it more. It promotes growth in children, synthesize DNA & acts on wound healing, it is best in treating initial diarrhea & cold cough. It improves learning, memory, fertility etc. It heals acne, attention deficit hyper activity disorder (ADHD), osteoporosis, pneumonia etc.

- ***Carbohydrate: -***

It is a macronutrient needed by the body, the body receives 4 calories per 1 gram of it; carbohydrate includes sugar, glycogen, starch, dextrin, fiber & cellulose that contains only oxygen, carbon & hydrogen. It is classified in simple & complex; simple carbs are sugar & complex carbs are fiber & starch which take longer to digest. It is basic source of energy for our body.

Main sources of carbohydrates: -

It is present in watermelon (little), potato, sweet potato, bread, oats, butter, white rice, whole grain rice, pasta, lentils, banana, pineapple, quince etc.

Basic pharmacokinetic of carbohydrate (based on human intake in natural food products): -

Its digestion begins in mouth; salivary glands releases saliva & salivary amylase (enzyme) which begins the process of breaking down the polysaccharides (carbohydrates) while chewing the food; now the chewed food bolus is passed in stomach through food pipe (esophagus); gastric juice like HCL, rennin etc & eaten material are churned to form chyme in the stomach; the chyme now is passed little by little down into duodenum, pancreatic amylase are released which break the polysaccharides down into disaccharide (chain of only sugars linked together); now the chyme passes to small intestine, in it, enzymes called lactase, sucrose, maltase etc breakdown disaccharides into monosaccharide (single sugar) & absorbed in upper & lower intestines, through villi present in small intestine & send into liver through venous blood present into portal veins, as per bodies need it is releases in the blood stream & pancreas release insulin to use it as source of energy for the body, & extra is stored is converted into glycogen by liver & stored in liver & little is stored in muscles & tissues. Liver can reconvert glycogen in to sources of energy if body lacks for other source of energy, the undigested carbohydrates reaches the large intestine (colon) where it is partly broken down & digested by many intestinal bacteria, the remains is excreted in stools.

Clinical pharmacology of carbohydrates: -

Carbohydrates are main sources of body energy, it helps brain, kidney, heart, muscles, central nervous system to function, it also regulates blood glucose, it acts on uses of protein as energy, breakdown of fatty acids & prevent ketosis. If we eat less carbohydrate it may lead to hypoglycemia, ketosis, frequent urination, fatigue, dizziness, headache, constipation, bad breath, dehydration etc.

Excessive intake of carbohydrates may lead to vascular disease, atherosclerosis (leads to narrowing of arteries, stroke, diabetes, obesity, fatty liver, blood pressure etc.

- ***Potassium: -***

It is a mineral with symbol K & atomic number 19, it is an essential mineral which body cannot prepare; it is necessary for heart, kidney & other organs to function, its low level in body is called as hypokalemia & high level is called as

hyperkalemia; it is mostly present inside the cells (intracellular); normal blood range is 3.5 to 5.0 milli equivalents per/liter (mEq/L).

Main sources of potassium: -

Potassium is naturally present in banana, orange, dates, raisin, broccoli, milk, chicken, sweet potato, pumpkin, spinach, watermelon, coconut water, white & black beans, potato, dried apricot, beetroot, pomegranate, almond, quince etc.

Basic pharmacokinetics of potassium (bases on human intake in natural food products): -

It is absorbed in small intestines by passive diffusion; it is stored mostly inside the cell, little in liver, bones & red blood cells. 80 to 90% potassium is excreted in urine & 5 to 20% is excreted in stools, sweat.

Basic clinical pharmacology of potassium: -

It is a mineral belongs to electrolytes of the body; it conducts electrical impulses throughout the body & assists blood pressure, normal water balance, muscle contraction, nerves impulse, digestion, heart rhythm, maintain pH balance. It is not produced in our body so we need to consume it through eating; Kidneys maintain normal level of it in the body by excreting excessive amount of it in urine or reabsorb it if the amount is less in the body so that the body may reuse it. Its deficiency may cause weakness, low blood pressure, constipation, nausea, vomiting etc.

Its normal amount in body keeps blood pressure normal; water balance in body normal; prevents heart disease, stroke, osteoporosis, kidney stone etc.

- ***Sodium: -***

Here we are learning natural sodium, its symbol is Na & atomic no. 11; it is not produced in the body we need to take it in food sources; it is an important & essential mineral on which our body functions; it regulates blood pressure, blood volume etc.

Main sources of sodium: -

Excessive intake of sodium should be avoided; It has very less amount of sodium; vegetables & fruits have less sodium in them which is good for the body. It is present in beans, meat, fish, chicken, chili, bread, rolls, milk, celery, beetroot etc.

Basic pharmacokinetic of sodium (based on human intake in natural food products): -

It is absorbed in ileum by active sodium transport because it is impermeable & in jejunum absorption takes place via mediated active transport & depends on levels of water, bicarbonate, glucose, amino acids etc; its absorption plays an important role in the absorption of chloride, amino acids, glucose & water; similar mechanism are involved in the reabsorption of it in kidneys when its level in the body falls. It is excreted mainly in urine, little in sweat & stools. It is stores in bones & dissolved in various body fluids.

Basic clinical pharmacology of sodium: -

It is amongst the essential electrolyte within the body, it remains in extracellular fluid (outside the cell) mainly, it carries electrical charges within the body, kidney maintain its normal level in the body, normal level is 135-145 milli-equivalent per liter (mEq/L), it is not produce in the body, it acts on muscles contraction, nerve cells, regulates blood pressure, blood volume; it takes part in every function of the body mostly, its low level in body is called as hyponatremia, it is found more in older aged, kidney disease, heart disease, hospitalized patient, this condition may cause brain edema, low blood pressure, fatigue, tiredness etc; its high level in the body is called as hypernatremia may cause increase in blood pressure, thirst, confusion, muscle twitching or spasm, seizures, weakness, nausea, loss of appetite, swelling in body etc.

- ***Vitamin B1 (Thiamin): -***

It is called as Thiamin also; it is a water soluble vitamin, it belongs to B-complex family, it is an essential micro nutrient which cannot be made by our body.

Main sources of vitamin B1: -

It is present in watermelon, spinach, legumes, banana, quince, wheat germ, liver, egg, meat, dairy products, nuts, peas, fruits, vegetables, cereals, rice, breads, oats etc.

Basic pharmacokinetic of vitamin B1 (based on human intake in natural food products): -

Intestinal phosphatases hydrolyze thiamin to make it free & absorbed in duodenum, jejunum mainly through active transport in nutritional doses & passive diffusion in pharmacological doses, very little is known about its absorption; it is metabolized in liver; it is excreted in urine & stored little in liver, heart, kidney, brain, muscles.

Clinical pharmacology of vitamin B1: -

It is needed for metabolism of glucose, amino acids (proteins), lipids (fats) etc; every cell of the body require it to form ATP (adenosine triphosphate) as a fuel for energy, also it enables the body to use carbohydrates as sources of energy; also nerve cells, heart cells, muscles cell require it to function normally; its deficiency causes beri-beri heart disease, weight loss, confusion, malaise, optic neuropathy, irritability, memory loss, delirium, muscles weakness, loss of appetite, tingling sensation in arms & legs, blurry vision, nausea, vomiting, reduce refluxes, shortness of breath etc; it is helpful to immune system; excessive intake of carbohydrates, protein, glucose (speacially in body builders, athletes etc) increases the need of vitamin B1.

- ***Vitamin B2: -***

It is also called as Riboflavin, it is a water soluble vitamin, it is an essential micro nutrient, it helps many systems of the body; it is not synthesized in human body.

Main sources of vitamin B2: -

It is present in watermelon, liver, milk, dairy products, nuts, egg, fish, leafy vegetables, almonds, mushroom, lean meat and quince.

Basic pharmacokinetic of vitamin B2 (based on human intake in natural food products): -

It is phosphorylated in the intestinal mucosa during absorption; mainly absorbed in upper gastrointestinal tract; the body absorbs little from a single dose beyond of 27mg; when excessive amount is eaten it is not absorbed; very little is known about its absorption. The conversion of it into its coenzymes takes place mainly in cells of small intestines, heart, liver, kidneys & throughout the body in many cells; it is excreted in urine & stored little in liver, heart, kidneys & in tissues of the body.

Basic clinical pharmacology of vitamin B2: -

It is needed by the body to keep skin, eyes, nerves, red blood cells healthy, it also helps adrenal gland, nerve cells, heart, brain to function; it also acts in metabolism of food, amino acids (protein), fats, helps to convert carbohydrate into energy (Adenosine triphosphate formation- the energy body runs on). It plays an important role in functioning of mitochondria. Its deficiency is called as Ariboflavinosis & causes weakness, throat swelling, soreness of mouth & tongue, cracks on skin, dermatitis, anemia, weak vision, itching & irritation in eyes, migraine.

- ***Vitamin B3: -***

It is called as Niacin or Nicotinic acid; it is in 2 forms niacin & nicotinamide acid; it is water soluble vitamin; it is an essential micro nutrient; it plays a role in over 200 enzymatic reactions in the body; It is produced in the body in small amount from tryptophan which is found in protein containing food & sufficient amount of magnesium, vitamin B6 & B2 (are needed to produce it).

Main sources of vitamin B3: -

It is present in watermelon, green peas, peanuts, mushroom, avocados, meat, egg, fish, milk, cereal, green vegetables, liver, chicken, coffee, potato, corn, pumpkin, tomato, almonds, spinach, enriched bread, carrots, quince etc.

Basic pharmacokinetic of vitamin B3 (based on human intake in natural food products): -

If eaten in natural form it is absorbed in stomach & small intestines by the process of sodium-dependent carrier-mediated diffusion in 5 to 20 minutes; if taken in therapeutic doses get absorbed by passive diffusion in small intestines. Its uptake in brain requires energy, in kidneys & red blood cells requires a carrier. It is metabolized in liver in 2 ways either is conjugated with glycine or niacin is form into nicotinamide; it is stored little in liver unbounded to enzymes. It is excreted in urine.

Basic clinical pharmacology of vitamin B3: -

It regulates lipid level in the body; it acts on carbohydrate to form energy sources for the body, it eases arthritis, boost brain function, every part of body needs it to function properly, it helps convert food into energy by aiding enzymes & cellular metabolism, it acts as an antioxidant. It prevents heart disease. Deficiency of it causes pellagra, high blood cholesterol, memory loss, fatigue, depression, diarrhea, headache, skin problems, lesion in mouth, tiredness etc.

- ***Vitamin B5 (pantothenic acid): -***

It is also called as pantothenic acid, it is water soluble vitamin, it is a micro nutrient, it is necessary for making blood cells; acts to convert eaten proteins, carbohydrate, fats into energy; it is a component of coenzyme A; it is used in synthesis of coenzyme A. (coenzyme A acts on transport of carbon atoms within the cell).

Main sources of vitamin B5: -

It is present in watermelon, quince, meat, chicken, liver, kidney, fish, grains, milk, dairy products, legumes etc.

Basic pharmacokinetic of vitamin B5 (based on human intake in natural food products): -

It is converted into free form by intestinal enzymes & in nutritional doses it is absorbed in intestinal cells via sodium dependent active transport system in jejunum & pharmacological doses are absorbed by passive diffusion; after absorption the free form of it is now transported to erythrocytes via plasma, in cells pantothenic acid is converted into CoA, all the body tissues can convert it into CoA & ACP (acyl carrier protein), after these two complete their jobs they are degraded to form free pantothenic acid & other metabolites. It is excreted in urine & stools & little in exhaled in carbon dioxide.

Basic clinical pharmacology of vitamin B5: -

It promotes skin, hair & eyes health, proper functioning of nervous system & liver, formation of red blood cells, making of adrenal hormones, sex hormones; it is very helpful in constipation, rheumatoid arthritis, acne, allergies, asthma, baldness, colitis etc.

Its deficiency causes fatigue, nausea, vomiting, irritability, neurological weakness, numbness, abdominal cramps, sleep disturbances, hypoglycemia etc.

- ***Vitamin B6: -***

It is also called as pyridoxine; it is involved in many aspects of macronutrients metabolism; it is present in many food products naturally.

Main sources of vitamin B6: -

It is present in watermelon, quince, chicken, bread, egg, vegetable, soybean, whole grain cereals, brown rice, fish, legumes, beef, nuts, beans, liver, citrus fruits, starchy vegetables, potato etc.

Basic pharmacokinetic of vitamin B6 (based on human intake in natural food products): -

It is absorbed in small intestines, but before absorption a phosphate group has to be removed making vitamin B 6 in free form & absorbed by passive transport, now reaches liver via portal vein, in liver to get metabolized & flown into the blood stream it is bound with albumin & some are taken up by red blood cells, once getting in blood it can function & promote health & it is excreted mainly in urine & little is excreted in stools, it is very little stored in tissues, muscle tissues, liver, brain, kidneys, spleen.

Basic clinical pharmacology of vitamin B6: -

It is needed for proper development & function of brain in children; it is needed for neurotransmitter, histamine, haemoglobin synthesis & function. It serves as coenzyme (cofactor) for many reactions in the body, it is the master vitamin for processing amino acids & some hormones, it is needed by the body to prepare serotonin, melatonin & dopamine, it is better to intake it during treatment of tuberculosis. It supports adrenal glands to function; it acts as a coenzyme in the breakdown & utilization of fats, carbohydrates, protein, it is important for immune system, it helps in treatment of nerve compression like carpal tunnel syndrome, premenstrual syndrome, depression, arthritis, high homocysteine level, diabetes, asthma, kidney stones etc.

Its deficiency causes seborrheic dermatitis (eruption on skin), atrophic glossitis with ulceration, conjunctivitis, neuropathy, anaemia etc.

- ***Folate (vitamin B9): -***

Folate is an essential micro nutrient, it is a natural form of vitamin B9, it serves many important functions of the body, it plays an important role in cell growth & formation of DNA, RNA & other genetic material & helps in treating many diseases; it name is derived from Latin word Folium, which means leaf, leafy vegetables have it in good amount; Folic acid is a synthetic form of vitamin B9.

Main sources of folate: -

It is present in watermelon, quince, dark green leafy vegetables, fruits, nuts, beans, dates, seafood, egg, dairy products, meat, chicken, legumes, beetroot, citrus fruits, broccoli, spinach, cereals etc.

Basic pharmacokinetic of folate (based on human intake in natural food products): -

Its absorption is complicated because folate present in food are of many different forms, some of which cannot be absorbed until broken down by intestinal enzymes; it is not absorbed more than 50%; dietary folate contains glutamate

that need to separate it from glutamate before absorption starts; It is absorbed in duodenum & jejunum, after absorption it is converted into tetrahydrofolate (the active form of folate), than a methyl group is added to it to form methyltetrahydrofolate; now the body uses it for various functions & metabolism; the body can store folate 20-70mg in liver which is enough for 3 -6 months for the body; it gets excreted in urine & little in stools & bile.

Basic clinical pharmacology of folate: -

It is needed by the body to make DNA, RNA & other genetic material; it prevents many disease & conditions like anaemia, stroke, cardiac diseases, cancers, neurological diseases, macular degeneration (eye disease), palpitation, sores in mouth & tongue, hair fall, graying of hair. It is important in fertilization in male & female, essential during pregnancy to prevent neural tube defect in embryo (it is needed more), it protect us from free radicals & oxidation thus prevent cancers, it is essential in red blood cells formation, reduces high levels of homocysteine.

Its deficiency may cause anaemia, tiredness, palpitation, breathlessness, hairfall, neural tube defect in baby during pregnancy etc.

- ***Vitamin B12: -***

It is called as Cobalamin, it is water soluble, it is involved in metabolism of every cell of body, it is a cofactor in DNA synthesis, myelin, fatty acids & protein, it is important for nervous system, it acts on red blood cell maturation; it is very less present in vegetables. When we eat animal source for it, B12 is protein bounded. Our body cannot produce it we need to consume it in food sources.

Main sources of vitamin B12: -

It is present in fish, meat, egg, milk, dates, organ like liver, kidney, olive fruit etc.

Basic pharmacokinetics of vitamin B12: - (based on human intake in natural food products):

It is absorbed in ileum (small intestine), when humans eat animal food the B12 is protein-bound. When the protein-B12 complex reaches the stomach, the stomach secretes acids and enzymes that detach the B12 from the protein. Then in a process unique to B12, another protein, R-protein (aka cobalophilin, haptocorrin, and transcobalamin picks up the B12 and transports it through the stomach and into the small intestine. R-protein is found in many fluids in the human body including saliva and stomach secretions. The stomach cells also produce a protein called intrinsic factor (IF), which travels to the small intestine. When the corrinoid-R-protein complex gets to the small intestine, the corrinoid is liberated from the R-protein by enzymes made by the pancreas. Of the liberated corrinoids, only the cobalamins attach to intrinsic factor. Intrinsic factor then carries the cobalamins to the last section of the small intestine, the ileum. The cells lining the ileum contain receptors for the cobalamin-IF complex. The cobalamin-IF complex protects the cobalamin against bacterial and digestive enzyme degradation. The IF-receptor also ensures that cobalamins will be given priority for absorption over non-cobalamin corrinoids. In addition to the IF mechanism, passive diffusion normally accounts for 1-3% of B12 absorbed when obtained through normal food sources. Some inactive B12 analogues are most likely absorbed through passive diffusion. It is metabolized in liver & excreted in urine. It is stored in liver for years mainly.

Basic clinical pharmacology of vitamin B12: -

It helps in formation of Red blood cells, prevent anaemia, prevent birth detect, promotes bone health, prevent osteoporosis, reduces risk of macular degeneration in eyes, improves mood & prevents depression, help nerve function & promote nervous health, boost energy, improves heart heath, nails, hairs, skin, memory, hormonal balance. It acts on wound healing, sooner recovery, ulcers, mouth ulcers etc.

Its deficiency causes anaemia, stress, weakness, stress, fatigue, delay wound healing, pain in nerves & tissues, joints, paleness, numbness in palms, feet etc. Diabetes & acidity medication reduces absorption of it in stomach & may lead to deficiency.

- ***Vitamin A: -***

It is a fat soluble vitamin; it is group of unsaturated organic compound that includes retinol, retinal, retinoic acid & several provitamin A carotenoid. There are 2 types of vitamin A, 1) Vitamin A: - found in meat, poultry, fish & dairy products; 2) Provitamin A: - found in fruits, vegetables, plants; beta carotene is common type of provitamin A; it is an antioxidant, reduces wrinkles & repairs the skin damages; it is available in the market as tretinoin in tablets & creams to heal acne.

Main sources of vitamin A: -

It is present in watermelon, fish oil, carrot, green leafy vegetables, citrus fruit, sweet potato, spinach, kale, quince etc.

Basic pharmacokinetic of vitamin A (based on human intake in natural food products): -

It is absorbed in jejunum mainly, little through skin; metabolism is in liver & excreted in urine & stools, it is conjugated with glucuronic acid & then changed into retinal & retinoic acid; retinoic acid is excreted in stool, mainly. It is stored primarily as palmitate in Kupffer's cells of liver, normal adult liver stores sufficient amount of it which is enough for 2 years for the body, little is stored in kidneys, lungs, adrenal glands, fats, retina; it is excreted in urine & stools.

Clinical pharmacology of vitamin A: -

it is needed by the body for vision and maintains eye health speacially retina; it prevents night blindness; it helps in normal reproduction of cells thus prevents cancer; it is required for proper growth & development of embryo throughout the pregnancy period, it is good for skin, supports immune function; helps the heart, kidneys & lungs to work properly.

- ***Vitamin C: -***

It is also called as Ascorbic acid; it is an essential water soluble vitamin, very much needed by the body for many functions & absorption etc.

Main sources of vitamin C: -

It is present in watermelon, citrus fruit, broccoli, cauliflower, sprouts, capsicums, papaya, strawberries, spinach, green & red chilies, cabbage, leafy vegetables, tomato, cereals, quince, cucumber etc.

Basic pharmacokinetic of vitamin C (based on human intake in natural food products): -

It does not need to undergo digestion, 80 to 90% of it eaten is absorbed by intestine cell border by active transport & passive diffusion & through ion channels it enters the plasma via capillaries. It is very little stored in adrenal glands, pituitary gland, brain, eyes, ovaries, testes, liver, spleen, heart, kidneys, lungs, pancreas & muscles. All together body can store 5 grams of it & we need 200mg/day in order to maintain its normal level & uses, but old, disease person, smokers & alcoholic need more daily value. It is excreted in urine in the form of dehydroascorbic acid changed by liver & kidneys both, but unused vitamin C is excreted intact.

Basic clinical pharmacology of vitamin C: -

It prevent cough & cold, repairs tissue, acts as an enzyme for curtain neurotransmitter, important for immune function, it is a powerful antioxidant (donates electron to various enzymatic & non-enzymatic reactions); body prepares collagen with the help of vitamin c; it is also helpful in Alzheimer's, dementia, acts on iron absorption, it protects the body from oxidative damages, reduces stiffness of arteries, reduces tendency of platelets to clump each other, improves nitric oxide activity (dilatation of blood vessels) thus prevents high blood pressure & heart disease, also prevent eye disease, reduces risk of cataract, prevents the lining of lungs & prevents lung disease, it is a natural antihistamine (anti-allergy), eliminates toxins from the body. Deficiency of it causes Scurvy disease (brown spots on skin occurs, swelling of gums, bleeding from all mucous membrane, spots are more on thighs & legs, the person looks pale, feel depressed, cannot move, loss of teeth, suppurative wounds occur.

- ***Vitamin E: -***

It is fat soluble vitamin; it is a group of eight fat soluble compounds that includes four tocopherols & four tocotrienols.

Main sources of vitamin E: -

It is present in olive oil, almonds, cereals, wheat germ, sunflower oil, corn oil, soybean oil, peanuts, green leafy vegetables & etc.

Basic pharmacokinetics of vitamin E (based on human intake in natural food products): -

It is absorbed in small intestines & metabolized in liver & distributed through lymphatic system & stored in fat droplets of adipose tissue cells; it is mainly excreted in stool, little in urine & through skin.

Basic clinical pharmacology of vitamin E: -

It prevents coronary heart disease, supports immune system, prevent inflammation, promotes eye health, lowers the risk of cancer; It is a powerful anti-oxidant thus reduces UV damage of skin, nourishes & protects the skin when applied on face; also promotes hair growth.

- ***Vitamin D: -***

It is a fat soluble vitamin; it is a group of fat soluble sec steroids responsible for increasing intestinal absorption of calcium, magnesium, phosphate etc.

Main sources of vitamin D: -

It is present in olive oil, fish, liver, egg yolk, milk, salmon oil, orange, cereals, soy milk, legumes etc.

Basic pharmacokinetics of vitamin D (based on human intake in natural food products): -

It is absorbed in small intestines; it is mainly excreted in stools. All forms of vitamin D are biological inactive (body cannot use it directly) & get activated in liver & kidney by some enzymes; it is mainly of 2 types, 1) Vitamin D3 (cholecalciferol) 2) Vitamin D2 (ergocalciferol). Both can be ingested from diet.

Vitamin D3 is naturally synthesis from cholesterol by skin on sun exposure (UVB short radiations). It is converted in liver into Calcifediol (25-hydroxycholecalciferol) & kidney converts it into Calcitriol & this is biologically active (usable by the body). Vitamin D2 is converted in liver into (25-hydroxyergocalciferol).

Basic clinical pharmacology of vitamin D: -

It increases absorption in intestines of calcium, magnesium, phosphate & many other minerals; it acts on metabolism of calcium, phosphate thus promotes bone health & growth, promotes remodeling of bones in children; it reduces inflammation, improves cell growth, neuromuscular functions, immune function, prevents osteoporosis (pores in bones), rickets in children. Calcitriol binds with vitamin D receptors (VDR) which are mainly present in the nuclei of target cells. Its deficiency may cause rickets (mainly in children), weak bones, weakness in muscles, fatigue, headache, blood pressure, inflammation in mouth, skin pigmentations, obesity etc.

- ***Vitamin K: -***

It is a fat soluble vitamin; it is essential for normal blood clotting; it occurs naturally in two forms, vitamin K1 (phylloquinone) which is widely distributed in plants; it is present in olive oil; Leafy vegetables are good sources of K1; vitamin K2 (menaquinones) is synthesized in alimentary tract by bacteria (Escherichia coli & other bacteria).

Main sources of vitamin K1: -

It is present in olive oil & also present in green leafy vegetables (spinach, kale etc) cauliflower, cabbage, broccoli, sprout, fish, liver, meat, egg, cereals etc.

Basic pharmacokinetics of vitamin k (based on human intake in natural food products): -

It is absorbed in small intestine; bile is required for it absorption & stored in fatty tissues & liver; it is excreted 40% to 50% in stools & 30% to 40% in urine.

Basic clinical pharmacology of vitamin K: -

It acts on synthesis of certain proteins that are prerequisites (necessary) of blood coagulation (means act on stop bleeding) & body also needs it to control the binding of calcium in bones & other tissues. Deficiency of it makes bones weaker, calcification of arteries & other tissues thus takes care of bones, joints & heart; it reduces tumour growth & is helpful in cancers.

- ***Sulfur: -***

Sulfur is an essential element for all life, but almost always in the form of organo-sulfur compounds or metal sulfides. Three amino acids (cysteine, cystine, and methionine) and two vitamins (biotin and thiamine) are organo-sulfur compounds. Many cofactors also contain sulfur, including glutathione, thioredoxin, and iron–sulfur proteins. Disulfides, S–S bonds, confer mechanical strength and insolubility of the protein keratin, found in outer skin, hair, and feathers. Sulfur is one of the core chemical elements needed for biochemical functioning and is an elemental macronutrient for all living organisms. Sulfur (in British English, sulphur) is a chemical element with the symbol S and atomic number 16. Elemental sulfur is a bright yellow; Sulfur is the third most abundant chemical in the human body. The element is also found in a number of foods such as garlic, onions, eggs, and protein-rich foods. Sulfur is necessary for the synthesis of the essential amino acids cysteine and methionine. It is helpful in osteoarthritis, muscles soreness, hair fall, antibacterial, antiviral, dandruff etc.

- ***Chlorine: -***

Natural chlorine is found combined with other elements chiefly sodium in the form of common salt (NaCl), but also in carnallite, and sylvite. Chlorides make up much of the salt dissolved in the earth's oceans: about 1.9 % of the mass of seawater is chloride ions. Natural chlorine is produced naturally by marine creatures (sponges, corals, sea slugs, tunicates, sea fans and jelly fish) and seaweed, plants, seeds, trees, fungi, lichen, algae, bacteria, microbes and insects. Chlorine kills bacteria & is a disinfectant. The most common compound of chlorine is sodium chloride (common salt); Chlorine is a highly reactive element which, whilst not existing by

itself in nature, exists in combination with other elements. These can be split into inorganic chlorinated substances like sodium chloride (common salt) and organic chlorinated substances (organochlorines) from sources like the ocean algae and plankton, forest fires and fungal activity. The oceans release around three million tonnes of one of these organochlorines (methyl chloride) into the atmosphere every year. In addition, some 5,000 – 15,000 million tonnes of inorganic chlorine go into the marine atmosphere each year from sea salt; Most of this inorganic chlorine is returned to the ocean surface, but 3-35% remains as "inorganic chlorine vapour". Some of this vapour is converted back into chlorine atoms that may react with natural organic compounds to give organochlorines. These in turn are then used by microbes.

- ***Silicon: -***

Silicon is a naturally occurring chemical element, whereas silicone is a synthetic substance. It is the 14th element on the periodic table. It's a metalloid, meaning it has properties of both metals and nonmetals, and is the second most abundant element in the Earth's crust, after oxygen. It readily bonds with oxygen and is rarely found in nature in its pure form. You've likely seen silicon as silicon dioxide or silica, better known as quartz, which is the most common component of sand.

- ***Lycopene: -***

It is a phytochemical of bright red colour carotene & carotenoid; it gives the red colour to the watermelon & other vegetables & fruits like tomato, pink guava, pink grapes, papaya etc. but it is not found in cherry & strawberries, although lycopene is chemically carotene but it has no vitamin A.

Main sources of lycopene: -

It is present in watermelon, olive, pink grapes, papaya, pink guava, grapes etc.

Basic pharmacokinetics of lycopene (based on human intake in natural food products): -

Absorption of it requires bile salts & fats to form a colloidal liquid & mostly absorbed in intestines. It is stored in the body in liver, testes, adrenal glands, ovaries, lungs, prostate gland & plasma; its excretion is not unknown. But if taken in higher doses it was found to be excreted in urine & stools both depending on the dose but when intake in natural fruits or vegetables the amount of it present is very little, that do not matter how it is excreted.

Basic clinical pharmacology of lycopene: -

It is a powerful antioxidant & anti-inflammatory thus prevents many types of cancers; it also reduces risk of cardio vascular disease because it helps in keeping the blood pressure normal; it prevents skin from various changes & degeneration, due its antioxidant action cleaning the skin from harmful effects of UV rays; it removes free radicals from the body which float in the body disrupting cells & causing deadly diseases like cancer, asthma, auto-immune diseases etc; it is also helpful in hair health & its problems; it inhibit 5 alpha reductase (means dihydrotestosterone blocker) & reduces PSA (prostate specific antigen) thus helpful in prostate enlargement & prostate cancer; also makes bones strong.

- ***Gallic acid: -***

It is also known as Trihydroxybenzoic acid; it is a type of phenolic acid; it is a group of hydrolysable tannins. It is used in pharmaceutical industries for various purposes.

Main sources of gallic acid: -

Tea, oak bark, strawberries, grapes, banana, clove, vinegar, gallnuts etc.

Basic pharmacokinetics of gallic acid: -

Its absorption, metabolism & excretion are not known yet and are under research.

Basic clinical pharmacology of gallic acid: -

It is anti-viral, anti-fungal, anti-oxidant, prevents cancers of colon, prostrate, leukemia without harming healthy cells, prevents neural disorders, anti-inflammatory, asthma, allergy, rhinitis, sinusitis etc.

- ***Homogentisic acid: -***

Homogentisic acid is also known as homogentisate or acid, homogentisic, belongs to the class of organic compounds known as 2(hydroxyphenyl) acetic acids. These are phenylacetic acids that carry a hydroxyl group at the 2-position. Homogentisic acid exists as a solid, slightly soluble (in water), and a weakly acidic compound (based on its pKa). Homogentisic acid has been found in human kidney, connective tissue and cartilage tissues,

and has also been detected in multiple biofluids, such as feces, urine, and blood. Within the cell, homogentisic acid is primarily located in the cytoplasm. Homogentisic acid participates in a number of enzymatic reactions.

- ***Omega 3: -***

It is also called as n-3 fatty acid, it is polyunsaturated fatty acid, it plays important role in human diet & physiology. It is of 3 type alpha linolenic acid, eicosapentaenoic acid (EPA) & docosahexaenoic acid (DHA).

Main sources of omega 3: -

Walnut, flex seed oil, clary seeds, algal oil, almond, hemp oil, fish, egg, fish oil, grape seed oil etc.

Basic pharmacokinetics of omega 3 (based on human intake in natural food products): -

Same as omega 6.

Basic clinical pharmacology of omega 3: -

It reduces risk of cardio vascular disease, cancer, heart disease, inflammation, symptoms of rheumatoid arthritis, promotes brain, nail, hair, skin, bone, joints health, reliefs depression, improves vision, strengthens the body.

- ***Omega 6: -***

It is a polyunsaturated fatty acid; it is also called as w-6 fatty acid or n-6 fatty acid; it is an essential fatty acid (our body needs it but cannot prepare it). The imbalance between omega 3 & 6 may lead to many health problems & heart problems.

Main sources of omega 6: -

It is present in egg, nuts, fish oil, whole grains, vegetables oil, flaxseed oil, grape seed oil, evening primrose oil etc.

Basic pharmacokinetic of omega 6 acid (based on human intake in natural food products): -

It is first hydrolyzed from eaten diet (mostly in triglycerides & phospholipids) by pancreatic enzymes, and then bile is secreted from gall bladder into intestines for further digestion (mostly in ileum). Linoleic acid is the parent compound of omega 6 fatty acid, during digestion & metabolism linoleic acid is converted into Gama linoleic acid & then into dihomo-gama-linolenic acid then into arachidonic acid then into adrenic acid. Its excretion is not yet known & is under research.

Basic clinical pharmacology of omega 6: -

It is beneficial in asthma, arthritis, vascular disease, thrombosis, atherosclerosis, cancer, stroke; increase health of skin, nails, hair, bones, eyes etc, also heals the wounds. But if taken too much in diet can cause high blood pressure, heart disease, blood clots etc.

- ***Choline: -***

It is water soluble vitamin & essential nutrient; it is a constituent of lecithin; it helps in many functions of the body.

Main sources of choline: -

It is present in watermelon, egg, peanut, fish, dairy products, wheat, beetroot, spinach, beans, whole grains etc.

Basic pharmacokinetics of choline (based on human intake in natural food products): -

Choline is mostly present in food in free form; it is absorbed in small intestine via transporter proteins & metabolized in liver; excessive choline is not stored but converted into phospholipids; it is changed into Trimethylamine in liver & is excreted in urine.

Basic clinical pharmacology of choline: -

It helps the nerves to develop signals. Our body makes some amount of choline, but should be consumed to avoid deficiency; it helps liver function, brain development, muscles movement, cell messenger system, DNA synthesis, nervous system, gall bladder function; it can be taken in pregnancy because it prevents neural tube defect. It aids in fats & cholesterol metabolism & prevent excessive fat building in liver.

- ***Betaine: -***

It is water soluble amino acid glycine; it is derivative of choline (choline is precursor of it) means body needs choline to synthesized betaine. It is also called as trimethylglycine (TMG) it has 3 methyl group attached to it; it was first discovered from beetroot & is called as betaine.

Main sources of betaine: -

It is present in watermelon, beetroot, wheat bran, spinach, grain, brown rice, sweet potato, beef, quinoa etc.

Basic pharmacokinetics of betaine (based on human intake in natural food products): -

It is absorbed in duodenum more than jejunum via sodium & chloride dependent transport & passive sodium independent transport system; it is rapidly absorbed in around 17 minutes & released into blood stream quite fast & its absorption is near complete; it is excreted very little in urine in form of dimethlyglycine (DMG) & little in stools, eliminated mainly via metabolism not excretion. It is stored in all organs (including brain) (it crosses blood brain barrier), skeletal muscles.

Basic clinical pharmacology of betaine: -

Betaine is a methyl donor, this means helps in liver function, cellular function & detoxification, process fats; it converts blood homocysteine into methionine. Homocysteine is an amino acid, body naturally produces, high level of it can be harmful to arteries of heart & may cause cardio vascular disease, arthrosclerosis by producing plague in the arteries of heart & brain (may cause stroke), may also cause osteoporosis, visual abnormalities, blood clots, narrowing & hardening of vessels.

Methyl donors: -

It refers to nutrients involved in bio-chemical process called as Methylation; And this process reduces due to age & we depend on methyl donor foods like vitamin B12, B6, folate, choline, betaine etc so that acts properly.

- ***Fluoride: -***

It is a naturally occurring mineral found in all sources of water & helps preventing cavities in teeth, makes enamel strong, prevents tooth decay, prevent teeth from acid attack. Makes immune system stronger, Excessive of it is injurious to health.

Main sources of natural fluoride: -

Tea, grapes, potato, coffee, shellfish, shrimps, water, rain water etc.

Basic pharmacokinetics of fluoride (based on human intake in natural food products): -

Much is not known about its absorption & metabolism. It is absorbed in stomach & small intestines, as it gets absorbed it rapidly enters mineralized tissues like teeth & bones; it does not get accumulated in soft tissues. Calcium & magnesium reduce its absorption.

- ***Silica: -***

It is an essential mineral; it is naturally present in vegetables, fruits etc; it is present in our body in a form of orthosilicic acid.

Main sources of silica: -

It is present in cucumber, wheat, onion, flex seed, avocados, banana, green beans, spinach, rice etc.

Basic pharmacokinetics of silica (based on human intake in natural food products): -

Its absorption, metabolism & excretion are yet not known & are under research. It is very little absorbed in the body & excreted in urine. It is stored in bones, tendons, aorta, liver & kidney.

Basic clinical pharmacology of silica: -

It supports & helps in bone health, connective tissues, skin, nails & hair health. It acts on depositing of minerals in bones thus promote bone health, it also acts as a stabilizer in the body & maintain balance between calcium & magnesium without balance of it we can have hormonal problem. It stabilizes body tissues, membrane, and arterial health. It helps to form collagen in body thus keeps skin health & act on wound healing.

- ***Beta carotene: -***

It is an anti-oxidant that converts into vitamin A & plays a very important role in human health; it is responsible for the red, yellow, orange colouration in some fruits & vegetables. It promotes eye health & prevents eye diseases.

Main sources of beta carotene: -

It is present in pumpkin, carrot, sweet potato, dark leafy vegetables, apricot, red & yellow pepper, spinach, kale etc.

Basic pharmacokinetics of beta carotene (based on human intake in natural food products):

It is absorbed in intestine by passive diffusion & get convert into provitamin A in the presence of bile acids, the intestinal mucosa plays a key role in converting it into provitamin A. it is transported in blood plasma exclusively by lipoproteins. The complete absorption, metabolism & excretion in not known fully. It is stored in fats & liver.

Basic clinical pharmacology of beta carotene: -

It is anti-oxidant, reduces risk of lung cancer & promote lung health, reduces free radicals thus prevents cancer & heart disease, diabetes, promotes skin health, improves complexion, hair health, eye health, brain health; reduces pimple, acne & other skin problems.

- ***Thymol: -***

It is a natural mono-terpenoid phenol mostly present in thyme plant; it has pleasant aromatic odour, it is anti-hook worm.

Main sources of thymol: -

Thyme oil, eye bright plant (Euphrasia rostkoviana), monarda didyma & origanum compactum.

Basic pharmacokinetics of thymol (based on human intake in natural food products): -

It is readily absorbed in intestines on oral administration; it is essentially excreted in urine within the first 24 hours after absorption.

Basic clinical pharmacology of thymol: -

It reliefs headache, diarrhea; it is anti-cancer, anti-septic, anti-inflammatory, antioxidant, anti-fungal, anti-spasmodic, anti-bacterial, prevent free radical, cardio vascular disease, it is analgesic, reduces lipids, treat pain & neurological diseases.

- ***Oleic acid: -***

Its short hand notation is C18:1, it is a non-essential (means it is produce naturally in the body) monounsaturated omega 9 fatty acid; It is insoluble in water & soluble in alcohol. It increases absorption of many drugs through skin by disrupting the lipids under the skin and penetration of the drugs, so its seed oil is best to be used with other applications on skin and used in cosmetic formulas.

Main sources of oleic acid: -

It is present in extra virgin olive oil is the best, also present in avocado oil, camellia oil, shea nut oil, apricot oil, sweet almond oil, whole egg, nuts, argan oil, pomegranate seed oil etc.

Basic pharmacokinetics of oleic acid (based on human intake in natural food products): -

It is believed that it is absorbed by different tissues mediated via passive diffusion to facilitate diffusion (this is under research) after taken up by the tissues it is stored in the form of natural triglycerides or oxidized, it is transported by lymphatic system; it is also believed to penetrate through skin (it is under research), its excretion is in stool. It is stored 98% in adipose tissues depots in form of triglycerides. Its metabolism & plasma half-life is yet not known.

Basic clinical pharmacology of oleic acid: -

It increases bioavailability of following medicines cortisol, hydrocortisone, betamethasone, 17 benzoate betamethasone, 17 valerate (betamethasone), ketarolac (anti-inflammatory), metronidazole, progesterone & estradiol.

Oleic acid prevents cardio vascular disease, blood pressure, skin disease, breast cancer, colon cancer, prostate cancer, stomach cancer, diabetes, gall stones, gastrointestinal disease and pancreatic disease. It reduces cholesterol, triglycerides, LDL, inflammation, swelling etc.

- ***Palmitic acid: -***

It makes up 7% to 13% of extra virgin olive oil; it is a common saturated fatty acid; it is the first fatty acid produced during lipogenesis (fatty acid synthesis) & from which longer fatty acids can be produced.

Main sources of palmitic acid: -

It is present in olive oil, flaxseed oil, soybean oil, sunflower oil, palm oil, cocoa butter, meat, milk & etc.

Basic pharmacokinetics of palmitic acid (based on human intake in natural food products): -

Its absorption, metabolism & excretion are under research.

Basic clinical pharmacology of palmitic acid: -

It softens the skin & keeps it moist thus good for psoriasis & eczema. It coats the skin, it is powerful anti-oxidant; it maintains the health of hair & skin from aging, cleans them from dirt, sweat, excessive sebum (main cause of acne and boil on face & other parts of the body).

- ***Linoleic acid: -***

It is a carboxylic acid; it is polyunsaturated with omega 3 & 6 fatty acids; its short hand notation is 18:2, it is an essential fatty acid that must be consumed for health.

Main sources of linoleic acid: -

It is present in olive oil, evening primrose oil, sunflower oil, walnut oil, hemp oil, grape seed oil, safflower oil, egg yolk, butter, pomegranate seed oil & etc.

Basic pharmacokinetics of linoleic acid (based on human intake in natural food products): -

It is first hydrolyzed from dietary fats & pancreatic enzymes & then with the help of bile it is absorbed in small intestine; metabolism & excretion are under research.
It gets converted into gamma linoleic acid (GLA) in the body, GLA is converted in the body into dihomo GLA (20 carbon chain) & it is converted into Arachidonic acid which is converted into Docosatetraenoic (long chain fatty acid with 22 carbons) acid.

Basic clinical pharmacology of linoleic acid: -

It acts on prostaglandin system of the body thus is anti-inflammatory, blood thinner, vasodilator (expand the blood vessel) it is very helpful in treatment of rheumatoid arthritis, breast lumps, fibro-adenoma (nodes in breast), cancers, reduces cholesterol, it prevents heart disease, diabetes, skin ulcers, irritable bowel syndrome etc.

- ***Ethyl butyrate: -***

Ethyl butyrate, is also known as ethyl butanoate, or butyric ether; it is an ester with the chemical formula $CH_3CH_2CH_2COOCH_2CH_3$. It is soluble in propylene glycol, paraffin oil, and kerosene. It has a fruity odor, similar to pineapple, and is a key ingredient used as a flavor enhancer in processed orange juices. It also occurs naturally in many fruits, albeit at lower concentrations. It is also naturally present in apples, bananas, apricot, plum, tangerine and orange juice. It has a strong diffusive fruity odor reminiscent of pineapple and banana.

- ***Ergosterol: -***

Ergosterol is a phytosterol consisting of ergostane having double bonds at the 5,6-, 7,8- and 22,23-positions as well as a 3beta-hydroxy group. It has a role as a fungal metabolite and a Saccharomyces cerevisiae metabolite. It is a 3beta-sterol, an ergostanoid and a member of phytosterols. Also ergosterol is a sterol that resides on the cell membranes of fungi and acts to maintain cell membrane integrity, similar to mammalian cholesterol.

- ***Anandamide: -***

Anandamide (ANA), also known as N-arachidonoylethanolamine (AEA), is a fatty acid neurotransmitter derived from the non-oxidative metabolism of eicosatetraenoic acid (arachidonic acid), an essential omega-6 fatty acid. The name is taken from the Sanskrit word *ananda*, which means "joy, bliss, delight", and amide. It is synthesized from *N*-arachidonoyl phosphatidylethanolamine by multiple pathways. It is degraded primarily by the fatty acid amide hydrolase (FAAH) enzyme, which converts anandamide into ethanolamine and arachidonic acid. As such, inhibitors of FAAH lead to elevated anandamide levels and are being pursued for therapeutic use. Anandamide is synthesized enzymatically in the areas of the brain that are important in memory, thought processes and control of movement. Research suggests that anandamide plays a role in the making and breaking of short-term connections between nerve cells, and this is related to learning and memory. It is also present in many plants that contain Cannabinoids. Anandamide plays a role in the regulation of feeding behavior, and the neural generation of motivation and pleasure.

- ***2,3-Butadione: -***

2, 3-Butadione is also known as dimethylglyoxal or Diacetyl, belongs to the class of organic compounds known as alpha-diketones. These are organic compounds containing two ketone groups on two adjacent carbon atoms. Thus, diacetyl is considered to be an oxygenated hydrocarbon lipid molecule. Diacetyl exists as a liquid, soluble (in water), and an extremely weak acidic (essentially neutral) compound (based on its pKa). Diacetyl has been found in human skeletal muscle and gonad tissues, and has also been detected in multiple biofluids, such as feces and saliva. Within the cell, diacetyl is primarily located in the cytoplasm. Diacetyl exists in all eukaryotes, ranging from yeast to humans. Diacetyl is a strong, sweet, and butter tasting compound that can be found in a number of food items such as rose hip, black salsify, winter savory, and bean. This makes diacetyl a potential biomarker for the consumption of these food products. Diacetyl is a potentially toxic compound. Diacetyl has been linked to the inborn metabolic disorders including celiac disease. Diacetyl (2,3-butanedione) is a naturally occurring product and can be found in numerous foods such as butter, milk, cheese, smoked or roasted meats, breads, fruits, vegetables, coffee, beer, and wine. Diacetyl is synthesized to be used as a food additive to impart

a buttery flavor. It also exists widely in many Plant essential oils, such as iris oil, angelica oil, laurel oil, etc. It is the main component of butter and other natural products fragrance.

- ***Absorption & digestion of amino acid.***

When we eat high-protein foods, body breaks down protein into amino acids and peptides through digestive enzymes, such as pepsin & pancreas produces trypsin, chymotrypsin and other that aid in protein digestion.

Pepsin is the primary enzyme responsible for digesting protein; it acts on the protein molecules & breaks the bonds – called peptide bonds – that hold the protein molecules together. Next, these smaller chains of amino acids move in the stomach & then in small intestine where they're further broken down by enzymes released by the pancreas. Small intestine contains finger-like extensions called micro-villi. These structures enhance its ability to absorb dietary nutrients. Now the semi digested material pass through brush border and baso-lateral membranes of small intestine & di-tripeptides are absorbed by passive transport (facilitated or simple diffusion) or active transport (Na+ or H+ co-transporters) pathways. Di and tripeptides are more efficiently absorbed than free amino acids which in turns are better absorbed than oligopeptides. They're released into the bloodstream and used for various biochemical reactions.

Each amino acid has a different role in the human body. Upon absorption, some amino acids are incorporated into a new protein. Some fuel your muscles and support tissue repair. Others are used as a source of energy.

Tryptophan and tyrosine, for example, promote brain health. These amino acids support the production of neurotransmitters, leading to increased alertness and optimum nerve responses. Tryptophan also assists with serotonin production, lifting your mood and keeping depression at bay.

Phenylalanine serves as a precursor to melatonin, epinephrine, dopamine and other chemicals that regulate your mood and bodily functions. Methionine helps your body absorb selenium and zinc, two minerals that promote overall health. Some amino acids, such as isoleucine, play a vital role in hemoglobin production and glucose metabolism.

- ***Tryptophan: -***

It is an amino acids (protein) that is useful in bio-synthesis of protein; it is essential in human because body cannot make it); it is a precursor of neuro-transmitter serotonin, melatonin, vitamin B3; it is a sedative also.

Main sources of tryptophan: -

Salmon oil, egg, spinach, milk, seeds, fenugreek seed, soy products, nuts, fish, meat, wheat, banana etc.

Basic pharmacokinetics of tryptophan (based on human intake in natural food products): -

It is absorbed in small intestine & reached the blood circulation, it passes the blood brain barrier & in brain cells it is metabolized into indolamine neuro-transmitter, niacin, a common example of indolamine is serotonin derivative from tryptophan. Tryptophan is converted into serotonin in the brain & body; it is believed that tryptophan supplements should be taken with carbidopa, which blocks the blood brain barrier. (Serotonin (5HTP) 5 hydroxytryptamine, is a monoamine neuro-transmitter. It contributes in feelings of well-being, happiness, reward, learning, memory, many physiological functions).

In the pathway of tryptophan/serotonin, melatonin hormone is produced. Melatonin regulates sleep-wake cycle. It is primarily released by pineal gland in brain. It controls circadian (daily clock) rhythms.

Pineal gland releases it at night more & very little in day light. It improves immune system function.

Natural sources of melatonin are tomato, pomegranate, olive, grapes, broccoli, cucumber, barley, seeds, nuts etc.

Fructose malabsorption causes improper absorption of tryptophan in intestine thus leading to low level of it & may cause depression.

Basic clinical pharmacology of tryptophan: -

It is necessary for normal growth of infants; nitrogen balance in adults, it aids in sleep pattern, mood. It is necessary for melatonin & serotonin formation in body, it enhances mental & emotional wellbeing, manages pain tolerance, weight etc. it also helps in build muscle tissue, essential for vitamin B3 production, relives insomnia, reduces anxiety, depression, migraine, OCD, helps immune system, reduces cardiac spasms, improves sleep patter etc.

- ***Threonine: -***

It is an amino acid used in biosynthesis of proteins; it is an essential amino acid important for tooth enamel, collagen, elastin, nervous system, fats metabolism, it prevents fats buildup in liver, useful in intestinal disorders, anxiety, and depression.

Main sources of threonine: -

Cheese, chicken, fish, meat, lentil, black seed, nuts, soy etc.

Basic clinical pharmacology of threonine: -

It is useful in nervous system disorders, multiple sclerosis, spinal spasticity, makes bones, joints, tendons, ligament stronger, it helps the immune system, promotes heart health.

- ***Isoleucine: -***

It is an amino acid that is used in the biosynthesis of proteins, it is an essential amino acid means the body cannot make it & we depend on food sources, it plays & helps many functions of the body.

Main sources of isoleucine: -

Meat, mutton, fish, cheese, egg, seeds, nuts, soybeans, milk, legumes, fenugreek seed etc.

Basic pharmacokinetics of isoleucine (based on human intake in natural food products): -

It is absorbed in small intestine by sodium-dependent active transport. It is metabolized in liver.

Basic clinical pharmacology of isoleucine: -

It promotes glucose consumption 7 uptake, it is anti-catabolic, enhances athletic performance & best for pre-workout, it acts on wound healing, detox of nitrogenous waste in the body, stimulates immune system, promotes secretion of many hormones, helps in haemoglobin formation, regulating blood glucose, energy in the body, built muscles, helpful to brain for its function.

- ***Leucine: -***

It is branched chain amino acid (BCAA) it is ketogenic amino acid; it is necessary when we do exercise, it stimulates protein synthesis & assists in muscle building.

Main sources of leucine: -

Cheese, soybean, meat, nuts, chicken, seeds, fish, seafood, beans.

Basic clinical pharmacology of leucine: -

It helps regulate blood glucose, promotes growth, recovers the muscles & bone tissues, acts on production of growth hormones, repairs the tissues, essential for muscle building, it burns fats, controls obesity, promotes lean muscles growth.

- ***Lysine: -***

It is an essential amino acid, which our body cannot prepare and we need to eat it from food sources. It necessary for many body functions, acts in building blocks of protein (muscles).

Main sources of lysine: -

Red meat, chicken, egg, fish, beans, lentils, wheat germ, nuts, soybeans, spirulina, fenugreek seed, shrimp, pumpkin seed, tuna, cheese, milk etc.

Basic pharmacokinetics of lysine (based on human intake in natural food products): -

It is absorbed from the lumen of the small intestine into the enterocytes by active transport, it undergoes first pass metabolism in liver & is metabolized in liver.

Basic clinical pharmacology of lysine: -

It helps the body in tissue growth, repair muscles injury, promote collagen formation, help the body to produce enzymes, antibodies, hormones, supports immune system, its deficiency causes fatigue, irritability, nausea, hair loss, anorexia, inhibited growth, anemia, problems with reproductive system, it is very helpful in treating cold sores (herpes), control blood pressure, diabetes, osteoporosis, helps athletes performance, helpful in treating cancers, reduces anxiety, increase absorption of calcium, improves digestion & prevent leaky gut, helpful in pancreatitis.

- ***Methionine: -***

It is a sulfur containing amino acid; it is essential; it plays a critical role in the metabolism & health; it act on normal cell functioning, growth & repair. It is also a chelating agent for heavy metals; due to its sulfur contain it is helpful in hair, nail health & growth & good for skin health; it reduces cholesterol by increase the production of lecithin in liver & reduces fats formation in liver, also protects kidneys, liver from hepatotoxins, it is an antioxidant. It is absorbed in lumen of small intestines into enterocytes by active transport & metabolized in liver.

Main sources of methionine: -

Meat, mutton, fish, chicken, cheese, egg, beans, milk, nuts, shellfish etc.

- ***Cystine: -***

It is the oxidized dimer form of amino acid, it is nonessential; the body uses it to produce taurine & other amino acids; it is a sulfur containing amino acid; our body uses vitamin B6 with the help of cystine; it heals burns, wounds, bronchitis, assist in supply of insulin, it increases level of glutathione in liver, lungs, kidneys & bone marrow. It is anti-aging, anti-inflammatory, anti-arthritis, anti-rheumatoid arthritis.

Main sources of cystine: -

Meat, egg, milk, garlic, onion, broccoli, oats, wheat germ, lentils etc.

- ***Phenylalanine: -***

It is an aromatic essential amino acid in human; it plays a key role in biosynthesis of other amino acids; it is important in the structure & function of many proteins & enzymes. It is precursor of melanin, dopamine, noradrenalin hormone, thyroxin hormone. It is converted in tyrosine & used in biosynthesis of dopamine & noradrenalin. It improves memory, reduces pain of hunger; it is anti-depressant; it is also a building block protein; it is useful in vitiligo, depression, ADHA, Parkinson's, multiple sclerosis, pain, osteoarthritis, rheumatoid arthritis, fat burn & helpful in alcohol withdrawal symptoms.

Main sources of phenylalanine: -

Pumpkin seed, nuts, seeds, soy, meat, fish, chicken, egg, beans, milk etc.

- ***Tyrosine: -***

It is a nonessential amino acid; it is also called as 4-hydroxyphenylalanine; it is useful in cell synthesis of protein; it is a building block protein; body prepares it from phenylalanine. It is a precursor & used to produce noradrenalin, dopamine, & thyroxin & melanin hormones. It reduces stress, improves memory, it promotes growth, mental health, skin health, fat burn. It acts as a mood elevator, anti-depressant, improves memory, mental alertness, its deficiency can cause hypothyroidism leading to low blood pressure, low body temperature (hypothermia), stress, fatigue, narcolepsy; it helps thyroid gland, adrenal gland, pituitary gland to function properly. It is absorbed in small intestine by sodium-dependent active transport; after absorption it reaches the blood & crosses the blood brain barrier (BBB) & enters the brain cells & gets metabolized into catecholamine (noradrenalin). Human body regulates it amount by eating it by food sources & making inside the body (nonessential). The body does not store it much for later uses.

Main sources of tyrosine: -

Meat, fish, egg, milk, nuts, beans, oats, wheat, black seeds etc.

Dopamine: -

It regulates reward & pleasure centers in brain; it is a chemical important for memory, motor skills & etc.

Nor-adrenaline & adrenaline: -

These hormones are responsible for fight & flight response in stressful situation & also controls many functions of the body; it is secreted by adrenal glands.

Thyroxin: -

It is secreted by thyroid gland; it regulates metabolism, blood pressure, digestion, energy etc.

Melanin: -

It is pigmented hormone, gives our skin, hair, eye their colour; dark skinned people have more melanin in their skin than light skin people (depend on exposure to sunlight).

- ***Valine: -***

It is an essential nutrient for vertebrates, biosynthesis of protein; it is an aliphatic & extremely hydrophobic essential amino acid; it is branched chain of amino acid (BCAA); it is important for growth, repair, blood glucose regulation, for energy; it stimulates CNS, proper mental function.

Main sources of valine: -

Cheese, soy, beans, nuts, fish, meat, chicken, mushroom, seeds, nuts, whole grains etc.

- ***Histidine: -***

It is an amino acid used in biosynthesis of protein; it is semi essential amino acid, needed by human for production of histamine & also for growth & tissue repair, it is helpful in maintaining myelin sheaths that covers the nerves & protects the nerves.

Main sources of histidine: -

Meat, mutton, fish, milk, egg, seeds, nuts, chicken, cheese, soy, beans, whole grains, fenugreek seeds.

Basic pharmacokinetics of histidine (based on human intake in natural food products): -

It is absorbed in small intestine via active transport requiring the presence of sodium.

Basic clinical pharmacology of histidine: -

It plays many roles in immunity, gastric secretion & sexual functions. It is also required for blood cell formation & protects tissues against damage of radiation & heavy metals. It keeps normal pH of 7 in the body, useful in rheumatoid arthritis, allergy, ulcer & anemia caused by kidney failure or dialysis. It is an antioxidant, anti-inflammatory, reduces cholesterol.

- ***Arginine: -***

It is among conditional essential amino acid the body needs to function properly; it is made in liver; it plays an important role in building protein thus helpful in body building.

Main sources of arginine: -

Chicken, pumpkin seeds, spirulina, dairy products, red meat, fish, egg etc.

Basic pharmacokinetics of arginine (based on human intake in natural food products): -

It is absorbed in jejunum mainly from oral diet.

Basic clinical pharmacology of arginine: -

It releases nitric oxide in the blood & nitric oxide dilates the blood vessels thus increases the blood supply & controls high blood pressure, it improves erection, builds muscle etc. it also acts on release of growth hormone, insulin & other substances in the body. It also improves heart health, athlete performance, stimulates immune system; citrulline present in watermelon is converted into arginine in kidneys, please refer lesson on watermelon.

- ***Alanine: -***

It is a non-essential amino acid that is present in blood plasma in its free state in high levels; it is involved in sugar & acid metabolism, protein synthesis, it increases immunity, provides energy for muscles tissues, brain & CNS, it acts on tryptophan, vitamin B6 metabolism; it is an important sources of energy for muscles; it helps the body to convert simple sugar (glucose) into energy; it is produced in the body. It increases exercise capacity; reduces muscle fatigue, boost immunity, it is antioxidant; anti-aging; increases muscle growth; ideal pre & post workout, reduce blood sugar, prevent liver disease, helps the liver to eliminate toxins, improves CNS functioning, helpful in benign prostate hypertrophy. It is digested in small intestine; it is converted into pyruvic acid by alanine aminotransferase-1; during fasting condition alanine derived from protein breakdown is converted into pyruvate & used to synthesis glucose by gluconeogenesis in liver, it is excreted in urine via urea cycle. It is stored little in skeletal muscles.

Main sources of alanine: -

Meat, fish, egg, milk, aleovera, honey, black seeds, nuts etc.

- ***Aspartic acid: -***

It is a non-essential amino acid; it is over all negatively charged & plays an important role in synthesis of other amino acid, citric acid & urea cycles; it is found in animals, plants, sugarcane, sugarbeet. It may be a neurotransmitter; it strengthens the muscles, improves heart function, helps in maintaining mental health, reduces tiredness, improves athletic performance, increases muscle size, reduces depression & fatigue. It is absorbed in small intestine by active transport.

Main sources of aspartic acid: -

Meat, oysters, seeds, oats, avocado, sugar beet, milk, egg, nuts, cereals etc.

- ***Glutamic acid: -***

It is a nonessential amino acid. It is an excitatory neuro-transmitter; it is necessary for biosynthesis of proteins; body uses it for several key functions within the body like making other neuro-transmitters such as GABA; it promotes brain health, muscles health, intelligence, mood & mental alertness. It is called as chemical messenger. It plays an important role in body's disposal of excessive waste like nitrogen. It is absorbed in lumen of small intestine into enterocytes by active transport & excreted in urine mainly. It is almost about 2 kilo gram
s, storage in natural form in brain, kidneys, liver, muscles etc.

Main sources of glutamic acid: -

Meat, chicken, fish, egg, milk, wheat, mushroom, soy, broccoli, walnut, peas etc.

- ***Glycine: -***

It is a nonessential amino acid that body needs for growth & maintenance of tissue & need to prepare hormones & enzymes. It is inhibitory neurotransmitter. It helps in preparing glutathione (a powerful antioxidant & reduces free radicals, delay aging). It is helpful in preparing of creatine (provides energy to muscles to perform exercise etc & acts on muscle contraction), beneficial for brain health, bone health, Alzheimer's, schizophrenia, sleep disorder, stroke, burns, protects kidney & liver from harmful side effects of drugs used after organ transplant, heals wound & ulcers, it is anti-inflammatory, improves skin health.

Main sources of glycine: -

Meat, fish, milk, legumes etc.

- ***Proline: -***

It is a protein-genic amino acid used in biosynthesis of proteins. It heals cartilages, cushion joints, tendons, ligament, heart muscles, connective tissues & helps in formation of collagen.

Main sources of proline: -

Soy, pumpkin seed, lentils, black beans, quinoa etc.

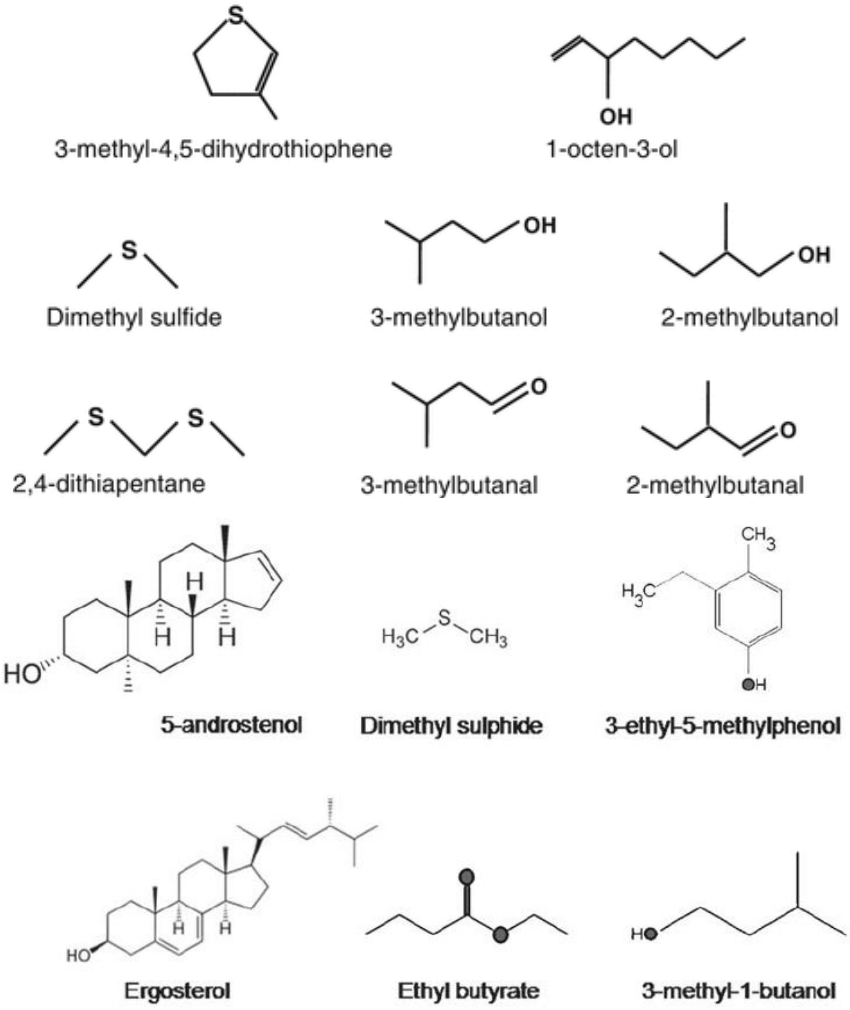
- ***Serine: -***

It is a nonessential amino acid, important for synthesis of protein, fats metabolism, muscle growth, immune system; it is a precursor of many amino acids, helpful in enzyme catalyze its reaction, overall health, physical & mental health.

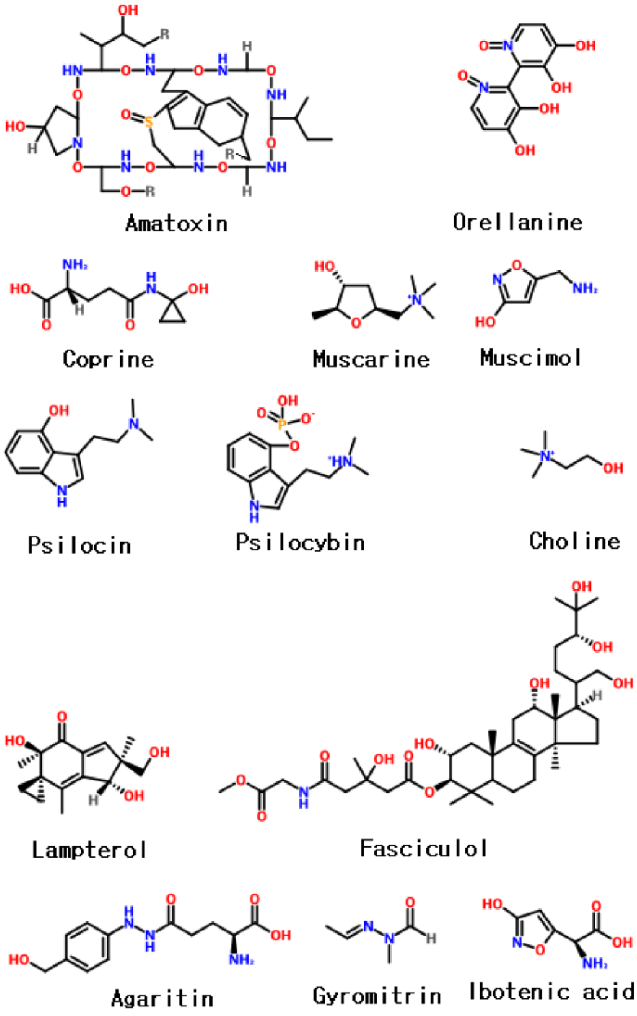
Main sources of serine: -

Soybean, egg, lentils, meat, fish, nuts, almonds, walnut etc.

- ***Chemical structures of truffle: -***



Chemical structures of mushrooms: -



- ***Researches on truffle: -***

1. Promotes Heart Health: -

Truffle oil is usually made using heart-healthy oils, such as olive oil as a base. Olive oil accounts for many of the health benefits of truffle, including its powerful effect on the health of your heart. Truffle oil is rich in polyphenols, which are natural compounds with antioxidant properties that can prevent oxidative stress and damage to your cells. Polyphenols can also help reduce inflammation, which is believed to be linked to a long list of chronic conditions, including coronary heart disease.

Studies show that these polyphenols can effectively reduce levels of cholesterol and triglycerides and lower blood pressure, and we know how high cholesterol, triglycerides and blood pressure are major risk factors for heart disease. A study published in the journal *BMC Medicine* even found that a higher intake of olive oil is associated with a reduced risk of heart disease.

2. Aids in Weight Loss: -

If you're looking to shed a few extra pounds, swapping the unhealthy, heavily refined and processed vegetable oils in your diet for truffle oil may be able to help. One human study published in the European Journal of Clinical Nutrition followed 187 adults over a three-year period and found that a diet rich in olive oil, the primary ingredient in truffle oil, was associated with a reduction in body weight.

Not only that, but dietary fat takes a long time to digest and can slow the emptying of your stomach, resulting in increased satiety and decreased hunger. Plus, fat can also reduce levels of ghrelin, the hormone responsible for stimulating hunger, more than carbohydrates, helping to ward off cravings and promote weight loss.

3. Preserves Brain Function: -

In recent years, there has been increasing evidence strengthening the connection between diet and brain health. Upping your intake of healthy fats, in particular, has been shown to have numerous brain benefits, especially when it comes to the prevention of cognitive disorders like Alzheimer's and Parkinson's.

According to one human study out of Pamplona, Spain, following a Mediterranean diet enriched with healthy fats was associated with better brain function compared to a low-fat diet. A 2013 animal model also found that a compound in olive oil had neuroprotective properties and was able to help reduce the risk of Alzheimer's disease by preventing the accumulation of a substance called beta-amyloid plaque in the brain.

4. Fights Cancer Development: -

Rich in powerful antioxidants, some research indicates that olive oil, the main ingredient in truffle oil, may help block the growth and development of cancer cells. Although studies in humans are still limited, in vitro studies have found that olive oil may be effective in killing off cancer cells and suppressing cancer growth. Plus, other studies indicate that olive oil intake may also be associated with a lower risk of cancer.

When made using actual truffle residues, real truffle oil may even boast some additional benefits over olive oil when it comes to fighting cancer cells. In fact, in vitro studies show that truffles are brimming with powerful antioxidants that can prevent the formation of cancer-causing free radicals in the body.

5. Keeps Skin Glowing: -

From reversing aging to speeding up wound healing, the long list of white truffle skin benefits is truly impressive. Truffle oil is rich in vitamin E, an antioxidant that can reduce inflammation and may aid in the treatment of conditions like atopic dermatitis, psoriasis and acne. A 2000 animal model in Japan also found that applying olive oil topically helped protect skin against UV exposure as well.

Not only that, but truffles are also commonly used in skincare products, serums and cosmetics alike. The extensive truffle benefits for skin stem from their rich antioxidant content, which can prevent oxidative damage, reduce skin aging, ward off wrinkles and smooth out skin tone.

6. Regulates Blood Sugar: -

High blood sugar can wreak havoc on health. In the short term, it can cause symptoms like fatigue, increased thirst, headaches and blurred vision. In the long term, however, it can have much more serious consequences, such as nerve damage, kidney problems and impaired wound healing. Truffle oil may help keep blood sugar in check by regulating levels of insulin, the hormone responsible for transporting sugar from the bloodstream to the cells, where it can be used as energy.

The olive oil found in truffle oil has been shown to increase insulin sensitivity, which can help maintain normal blood sugar levels. A 2017 review composed of four studies and 15,784 adults showed that people consuming the highest amounts of olive oil had lower levels of blood sugar, plus a 16 percent lower risk of developing type 2 diabetes**.**

- ***Researches on mushrooms: -***

A new study published in the *International Journal of Cancer* found an inverse relationship between mushroom consumption and the development of prostate cancer among middle-aged and elderly Japanese men, suggesting that regular mushroom intake might help to prevent prostate cancer. A total of 36,499 men, aged 40 to 79 years who participated in the Miyagi Cohort Study in 1990 and in the Ohsaki Cohort Study in 1994 were followed for a median of 13.2 years. During follow-up, 3.3% of participants developed prostate cancer. Compared with mushroom consumption of less than once per week, consumption once or twice a week was associated with an 8% lower risk of prostate cancer and consumption three or more times per week was associated with a 17% lower risk. "Since information on mushroom species was not collected, it is difficult to know which specific mushroom(s) contributed to our findings. Also, the mechanism of the beneficial effects of mushrooms on prostate cancer remains uncertain," said lead author Shu Zhang, PhD, of the Tohoku University School of Public Health, in Japan. Wiley. "Eating mushrooms may help lower prostate cancer risk." ScienceDaily. ScienceDaily, 5 September 2019. <www.sciencedaily.com/releases/2019/09/190905080106.htm>.

A simple, portable test that can detect the deadliest of the mushroom poisons in minutes has been developed by Agricultural Research Service (ARS) scientists and their colleagues. Eating toxic mushrooms causes more than 100 deaths a year, globally, and leaves thousands of people in need of urgent medical assistance. Amanitin is the class of mushroom toxins that cause the most serious issues.

The new test can identify the presence of as little as 10 parts per billion (equivalent to 10 cents out of $10 million) of amanitin in about 10 minutes from a rice grain size sample of a mushroom or in the urine of someone who has eaten a poisonous amanitin-containing mushroom. The test also works with dog urine, as dogs are known to indiscriminately eat mushrooms.

"We developed the test primarily for mushrooms as food products. Serendipitously, it was sensitive enough to also detect the toxin in urine," said ARS microbiologist Candace Bever, who worked on the development. Bever is with the Foodborne Toxin Detection and Prevention Research Unit in Albany, California.

In their latest feat of engineering, researchers at Stevens Institute of Technology have taken an ordinary white button mushroom from a grocery store and made it bionic, supercharging it with 3D-printed clusters of cyanobacteria that generate electricity and swirls of graphene nanoribbons that can collect the current.

The work, reported in the Nov. 7 issue of *Nano Letters*, may sound like something straight out of Alice in Wonderland, but the hybrids are part of a broader effort to better improve our understanding of cells biological machinery and how to use those intricate molecular gears and levers to fabricate new technologies and useful systems for defense, healthcare and the environment.

"In this case, our system -- this bionic mushroom -- produces electricity," said Manu Mannoor, an assistant professor of mechanical engineering at Stevens. "By integrating cyanobacteria that can produce electricity, with nanoscale materials capable of collecting the current, we were able to better access the unique properties of both, augment them, and create an entirely new functional bionic system."

Cyanobacteria's ability to produce electricity is well known in bioengineering circles. However, researchers have been limited in using these microbes in bioengineered systems because cyanobacteria do not survive long on artificial bio-compatible surfaces. Mannoor and Sudeep Joshi, a postdoctoral fellow in his lab, wondered if white button mushrooms, which naturally host a rich microbiota but not cyanobacteria specifically, could provide the right environment -- nutrients, moisture, pH and temperature -- for the cyanobacteria to produce electricity for a longer period. Mannoor and Joshi showed that the cyanobacterial cells lasted several days longer when placed on the cap of a white button mushroom versus a silicone and dead mushroom as suitable controls. "The mushrooms essentially serve as a suitable environmental substrate with advanced functionality of nourishing the energy producing cyanobacteria," says Joshi. "We showed for the first time that a hybrid system can incorporate an artificial collaboration, or engineered symbiosis, between two different microbiological kingdoms."

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^ See: Thérèse Dereix de Laplane (2010) "Des truffes sauvages aux truffles cultivées en Loudunais" (From wild truffles to cultivated truffles in the area of Loudun), Mémoires de l'Académie des Sciences, Arts et Belles-Lettres de Touraine, 23 : 215–241. Available on-line at: Academy of Touraine From pp. 224–225: " ... le paysan, a alors l'idée, vers 1790 — puisqu'il y a symbiose évidente entre le chêne, les galluches et la truffle — de provoquer la formation de truffières, en reproduisant leur environnement naturel par des semis de glands dans ses "terres galluches". Avec "les glands venus sur les chênes donnant les truffes, des semis furent faits dans les terrains calcaires voisins" ... " (the farmer [viz, Pierre II Mauléon] then had the idea, around 1790 — because there is an obvious symbiosis between the oak tree, the rocky soil, and truffles — of inducing the formation of truffle patches, by reproducing their natural environment by sowing acorns in his rocky soils. With "the acorns [that] came from the oak trees producing truffles, sowings were made in the neighboring chalky plots")
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- ***Conclusion of truffle lesson***: -

Truffle plantations are being established, but they are riddled with a variety of challenges. The biological roles are also scantily-evaluated, unlike mushrooms, which render some potential consumer's skeptic regarding their food safety. Awareness of their present standing might kindle interest among researchers to investigate their food and health scopes and to design strategies to enhance productivity. Truffles are the macrofungi that form underground (hypogeous) fruit bodies. These true truffles of Tuber genus belong to ascomycetes (spore sac fungi). The fungi live in ectomycorrhizal association with a broad variety of gymnosperm and angiosperm hosts in a variety of habitats including subtropical cloud forests, temperate forests, boreal forests, floodplains, tree nurseries, restoration sites and Mediterranean woodlands. It is antioxidant, antiviral, anti-microbial, hepatoprotective, anti-mutagenic, anti-inflammatory, anti-carcinogenic, and anti-tuberculosis.

- ***Conclusion of mushroom lesson: -***

Mushrooms can be used as source of alternative food in addition to fortification or supplementation of diet for enhanced nutrition, thanks to their high content of bioactive compounds. The most studied mushrooms were Agaricus bisporus and Boletus edulis in terms of chemical composition and bioactive compounds. Studied mushrooms proved to be rich sources of proteins, carbohydrates and ash containing also different bioactive compounds such as flavonoid compounds, phenolic compounds and antioxidant activity. Polyunsaturated fatty acids predominated over mono and unsaturated fatty acids. The studied mushroom species are poor in fat content, making them low caloric foods. Furthermore, all these samples revealed antioxidant activity, being B. edulis more effective in ABTS and reducing power assays. It contains all nutrition required for human body.

- ***SCIENCE & HADEES REGARDING TRUFFLES & MUSHROOMS: -***

Truffles are an important source of protein among the desert plants.
The compositions are as follows: - It has 77% water and 23% other substances. These substances include 60% hydrocarbons, 7% fats, 4% fibers, 18% proteins, and the remaining 11% are in the form of ashes that remain after its burning. Seventeen amino acids have already been recognized in the proteins present in the truffles.
When Prophet ε describes the truffles as manna, this actually implies that they grow by the Will and Grace of Allah as they are not cultivated by

man. Moreover, they require neither seeds nor water to grow. The only interference by man in this process is to exert effort in their gathering. As for the other description given by Prophet صلى الله عليه وسلم that "Their water is healing to the eye", Ibn Sina mentioned that Muslims, in response to this Hadees used to boil its water, cool it and then use it as eye drops. Dr. Al-Mu`taz al-Marzuqi, an Egyptian Ophthalmologist, tried to study this Hadees in the light of modern science, and reached very important results.

He found that the water of truffles prevents the occurrence of fibrosis in cases of eye trachoma. Truffles stop the formation of the fibrous tissues in the infected area. Experiments have proven that the application of the water of truffles in the treatment of trachoma has led to an enormous drop in the formation of lymphatic cells resulting from inflammation, which may lead to opacity of the cornea. Trachoma is a chronic contagious inflammation from which most inhabitants of the Arab world, the Mediterranean region and others all over the world suffer. The complications resulting from this disease may lead to total blindness.

Trachoma with its various complications is found to be completely responsible for more than 25% of the cases of blindness in areas where the disease is widespread. Very often, trachoma is also accompanied by spring ophthalmia, which increases fibrosis in the infected area. Experiments carried by Dr. Al-Mu`taz Al-Marzuqi have proven that the water of truffles remarkably reduces the occurrence of fibrosis in the eye cornea, through stopping the growth of the cells which form the fibers, equalizing the chemical effect of the trachoma poisons and inhibiting the unnatural growth of the cells of the conjunctiva, because most of the complications of trachoma occur because of fibrosis of the cornea that are cured by the water of truffles (By Dr. Zaghloul El-Naggar).